AMERICAN MACHINIST

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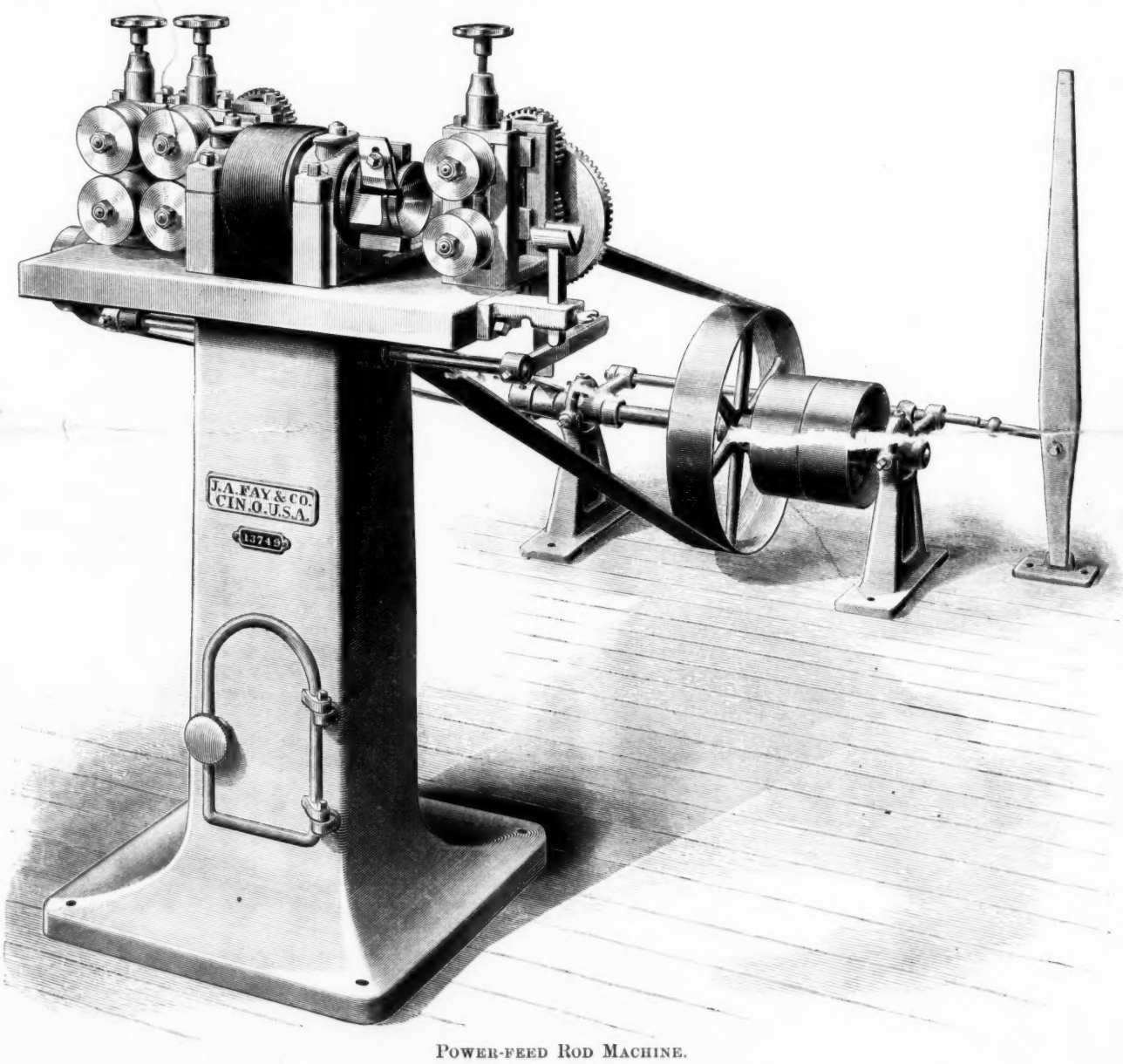
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Power-feed Rod Machine.

We illustrate herewith a newly designed machine for turning "stretchers," curtain poles, flag sticks and similar round rods of wood.

The machine consists essentially of a hollow spindle mounted in suitable bearings at the top of a rectangular column, this hollow spindle being provided with a cutter head at one end, through which the stock passes. There are three pairs of feed rolls, one pair being in front to deliver the stock, and two pairs at the rear of the cutter spindle to draw out the finished rod. The pressure is independently adjustable upon these rolls; they are driven by a separate belt at two rates of feed—14 and 16 feet per minute. The feed rolls can readily be removed or swung out of the way when removing or replacing the cutter heads.

An important feature of the machine is the mechanism for reversing the feed, which sometimes becomes necessary in order to examine the work, or to remove a rod before it is turned its entire length. This is accomplished by a system of gears controlled by a conveniently located spring lever. The machine is built by J. A. Fay & Co., Cincinnati, Ohio.



POWER-FEED ROD MACHINE.

The following is given as the performance of an English locomotive, which it is claimed will be hard to beat by an engine in this country:

A tank engine, with cylinders 17 in. diameter, 24 in. stroke, six coupled wheels, 4 ft. 9 in. diameter, weighing 40 tons, hauled twenty-five loaded wagons, weighing 15 tons each = 375 tons, and with the engine a total weight of 415 tons, up a bank of 1 in 90, which is equal to hauling 1,245 tons on a level road.

Machine Shop Milling Practice—IV.

BY HORACE L. ARNOLD.

There can be and is a great difference in ways of making mills. A "mill" may be defined as an assemblage of cutters having a common axis of rotation, all of whose cutting edges lie in approximately the same circle when measured on any one plane at right angles to the axis of rotation. With this broad definition a 2 or 3 or 4 cutter boring head would be classed as a mill, though in the machine shop it would never be called a mill, and it will at once be seen that at some dimensions it becomes more economical to make each mill tooth a separate piece so fixed in a soft mill body as to be held securely than to form all the teeth and the body out of one piece of tool steel, with all the risks of hardening to be taken. The limit of size at which combination or cutter or tooth insertion shall take place is not governed by actual dimensions, but mainly by the form of the cut to be produced. For plain mills, in which all axial sections of the solid generated by the mill revolution are rectangles, or what would be called plain round mills, the same toolmaker would under varying conditions of use overlap the diameters of solid and inserted tooth mills through a long range of common dimensions, and for some jobs might make mills with inserted teeth as small as 2″ or 3″ diameter, while for other jobs solid mills would be made as large as 10″ or 12″ diameter. Gang mills are seldom made with inserted teeth, and the same is true of "form" or profile mills.

I may here say that while there is now no really settled nomenclature of mills, and the names of different forms of mills, or mills which cut in different ways, vary in various shops, there has been an effort made by Brown & Sharpe towards uniform practice, and their names have been followed here, though I personally regret that the names adopted by Brown & Sharpe are not purely in the English language. Brown & Sharpe call a mill which cuts on its side an "axial" mill; "side" mill is the common name, and is the shorter, and is English. For the "end" cutting mill or "butt" mill, the term "radial" has been fixed upon, and again "end" is the shorter word, the more descriptive, and is English. For side mills which produce another than flat cut, the name of "form" mill has been introduced by Brown & Sharpe, and although the "profiling" machine has educated the factory milling machine hands to the common use of the term "profile cut," for a cut which is not flat, probably "form mill" is the most suitable short name for mills which make an "axial" cut which is intentionally not flat. "Side," "end," and "form" would have been three short and perfectly descriptive terms, and I should not be surprised if they survived and prevailed in common use in spite of the high authority conferred by the sanction of the Brown & Sharpe catalogue, which is surely the most popular and universally used and appreciated "tool-maker's companion" ever printed.

Mills of various forms, by whatever name they may be known, are made with inserted teeth, and these inserted teeth may be either driven, keyed or screwed in place, or secured by separate screws. Only Pratt & Whitney methods of mill-making will be noticed at this time, as I prefer to describe only what I see, as I see it.

Fig. 13, page 2, shows two fine examples of Pratt & Whitney gangs of solid mills, the upper one being for the top of their 13″ lathe bed, and the lower one for the top of their "No. 3 screw machine" bed. The arbor hole in the mills is 2¼″ diameter, and the largest mills in the gangs which are both axial and radial in their cuts are 7⅞″ and 8¼″ diameter, respectively, while the large end of the taper is 3″ diameter, and the ends projecting through the nuts are 2″ diameter. It will be noticed that the taper shanks are fitted with "Woodruff" keys; these are ½″ thick by 3″ long, and will resist a shearing strain of say 35 tons. Mills of this class and form are so well known that little space is demanded for their description; they are made of the best steel, the one long cut is made spiral, and such numbers of teeth are selected for each mill as will break up the cut as much as possible.

The faces on which the chips slide as they are cut, and against which they rub *hard* while in the process of chip-formation or cutting, are radial planes in the axial mills, and axial planes in the radial mills; that is, radial planes in the side mills and axial planes in the end mills. In other words, the chip is cut in exactly the same way it would be if a boring or facing cut were made in the lathe with a "flat, square-nosed" tool. Of course, no lathe hand who wished to surface, say, a cylinder head on the face-plate of the lathe would grind his tool perfectly flat on top for the roughing cut, nor would he, if he wished to remove stock with a boring tool, in all cases use a flat top tool. For the face-plate work the tool would be "lipped up," so that the surface against which the chip slides off would stand at an angle of from, say, 15 to 40 or 45 degrees with the cut, instead of at right angles to the cut as it does in milling. It is well known that flat-nosed tools are only

suitable for removing thin chips, and hence this right-angle cutter face may be the sole cause of the smallness of the feed per tooth in all the examples of mill cuts so far given.

There was once, and perhaps is yet in some places, a good deal of trouble taken to give mill teeth all the "rake" or the smallest cutting face angle possible; but as will be no doubt of the superiority of the "hooking" or "raking" tooth when viewed simply as a stock-remover. But there are many other points beside simply getting repair them if the faces are radial, and the radial tooth has the greatest strength with the greatest grinding clearance that can be given to a mill tooth. Again, although the

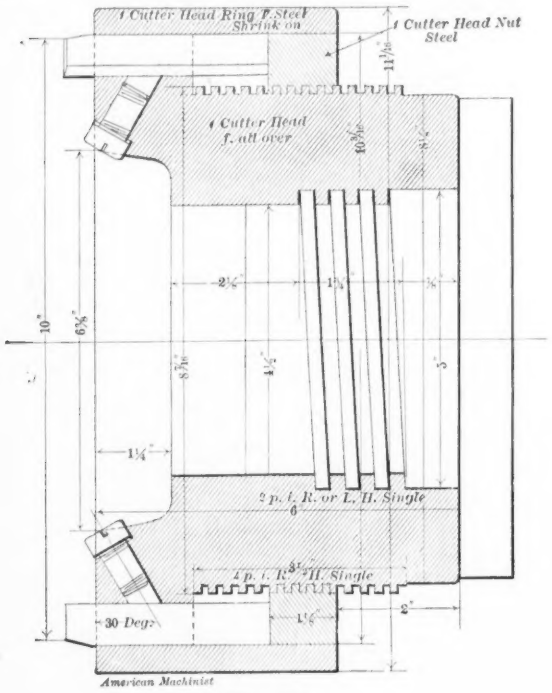


Fig. 26

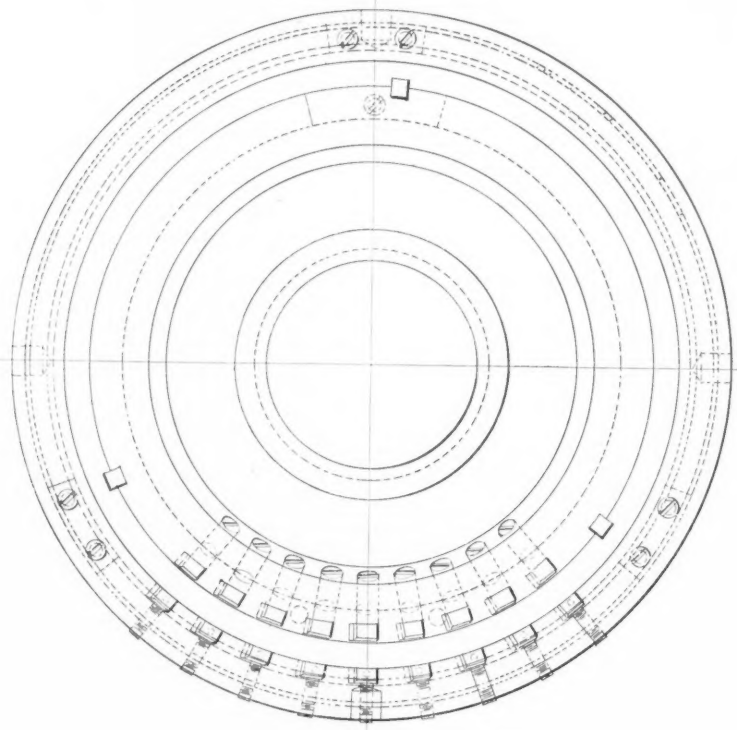


Fig. 30

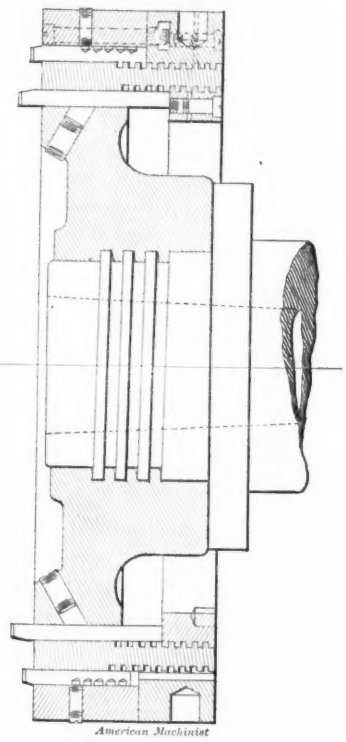


Fig. 29

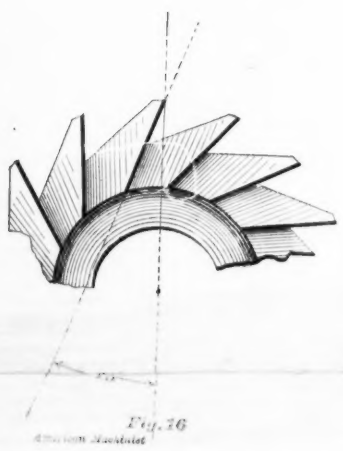


Fig. 16

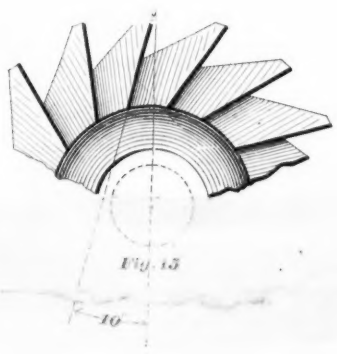


Fig. 15

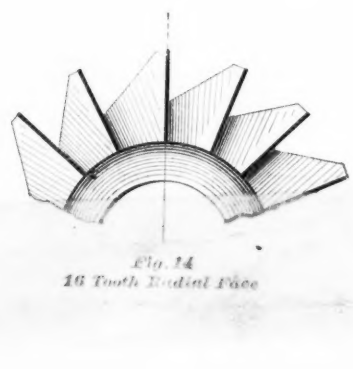


Fig. 14
16 Tooth Radial Face

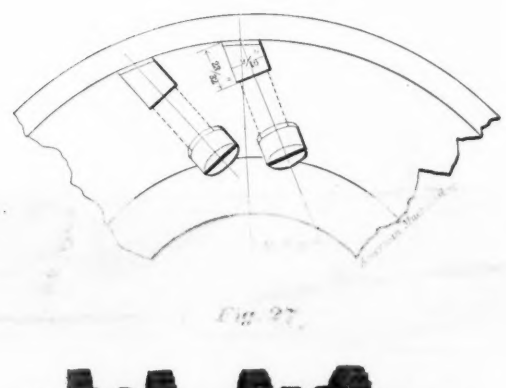


Fig. 27

Fig. 17.

Fig. 19.

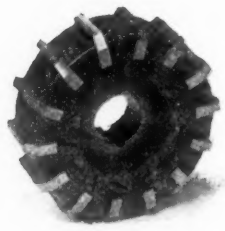


Fig. 18.

Fig. 20.

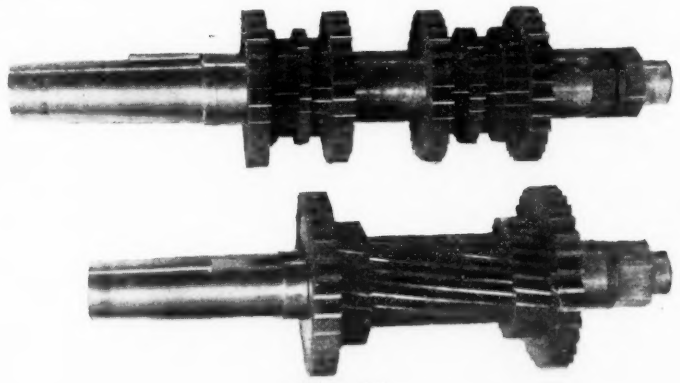


Fig. 13.

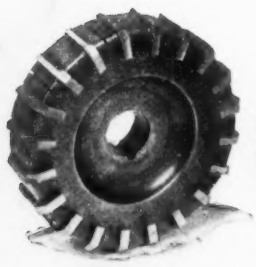


Fig. 21.

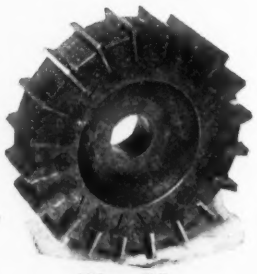


Fig. 23.

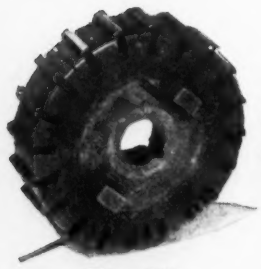


Fig. 22.

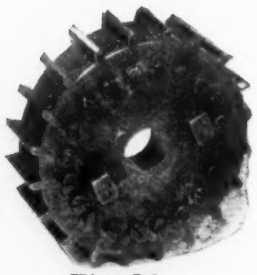


Fig. 24.

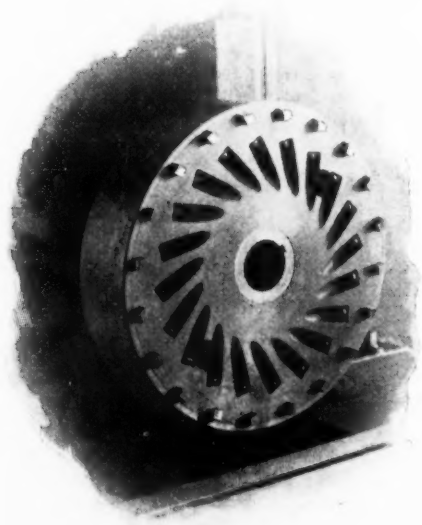


Fig. 25.

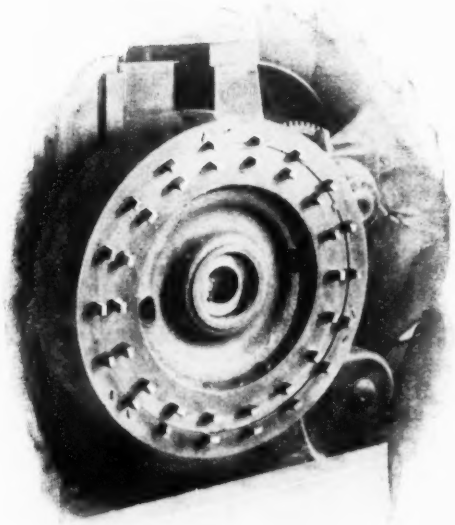


Fig. 28.

MACHINE SHOP MILLING PRACTICE.

Be that as it may, the settled and almost invariable practice in the Pratt & Whitney shops is to cut all mill teeth with radial faces, and to insert all mill teeth in radial slots in the cutter body.

be seen by inspection of Figs. 14, 15 and 16, raking teeth are both weak and difficult to produce, and there is, therefore, good tool-making ground for the radial face mill tooth practice, while at the same time there can

away with metal to be considered in mill-making. First, mills must be made, and second, they must be used in order to make them economical tools for the shop. It is easier to make the mills and to grind and

radial face does not give the easiest cut, it has the greatest endurance, and will go over more surface with the same time spent in grinding; and mill grinding is, in most cases, an expensive operation, and is to be

studiously avoided. And again, the mill is our present final effort to increase the per man production by enabling one hand to attend to many cutting edges.

My first introduction to the machine shop contract or piece-work system, where one man has all the lathes or planers he can use furnished him, brought me face to face with what seemed a flat contradiction of things. I was familiar with shops where one man to one tool was the rule. In such a shop when work is "pieced" the contractor makes his one machine do all it can possibly do; the tools are ground to a small cutting angle, and the greatest depth of cut that can be used is used. As I walked through this shop where all was contract work, with what seemed to me like here and there a man lost in a wilderness of tools all running, I noticed with surprise that all the feeds were fine, all the cutting tools had large cutting angles, and that the production of work per tool was ridiculously small. At the office I was wrongly informed that the men ran fine feeds and thick cutting edges so as to hold each tool as long as possible, because when a lathe or planer was empty any man near by could claim it for his own work if he had work for it, and that each man consequently held all the tools he could as long as possible, so that he could have as many at his disposal as possible all the time, because he wanted to be able to select that most suitable for the particular job he wished to push. This was not true at all, although I got the information from the proprietor, who had himself been a workman, and should have been able to tell me the true cause for the fine feeds and large cutting angles. I went back to the machine floor and had the tools ground for efficiency, and had the original feed cones put back on the machines—many of them had been taken off on the driving side and the belts put on the bare cone studs to reduce the lathe feeds to a fineness I had never dreamed of—and put things to rights generally in spite of very emphatic protests from the contractors. The result was more tool grinding, more work per tool, plenty of lathes and planers idle, contractors busy as bees, and less work *per man* than under the old system, and hence the shop would have had to pay *more* for the work with the machine tools run up to their capacity, in order to give the contractors the same money, than if more tools had been used and the product of each tool had been less with less contractor's time spent on it. After a great deal of annoyance and ill-feeling the contractors got back into their old way, and made their old pay, and I had a disagreeable experience to remember.

Yet I can never walk past a lot of planing machines, for instance, taking small cuts with tools having bad cutting angles, without having to think twice before I can remember why they are not urged to at least a fair efficiency; it is solely because the angle of greatest cutting tool efficiency is *not* the angle of greatest cutting tool durability. Where metal cutting edges are brought down very fine and thin, they cut beautifully, and as is well known, lathe and planer tools can be ground so as to hold themselves in the cut, so that a lathe will take a nice cut over a shaft without the use of the machine feed at all, the chip cut forcing the tool and carriage along, but this edge is not the edge that will cover the greatest surface with the least grinding. The old "heel tool" and "button head tool" hand tool users knew all about the easy cutting angle, and could roll off a shaving of wrought-iron which would not discredit a modern engine lathe with a shoulder tool guided by their hands, but that was not the most work per man way, nor the most surface finished for a dollar way. Because I can remember these things, and because I believe that the good lives and the bad dies, I am not prepared to find the least fault with the radial face mill tooth, or the fine per tooth feed of milling machines that look as if they ought to cut two feet per minute instead of the two inches per minute they do cut.

As I said, the Pratt & Whitney practice for solid and inserted tooth mills is an approximately radial tooth face; the angle of the spiral is also made constant, though it would seem that it might be varied to advantage in the *cut;* it cannot be varied to advantage in the tool maker's department—it is "regular" at a seven degree angle to the axis, and is not varied except for urgent reasons. The cutting mills for the "axial" or side teeth vary from 10 to 30 degrees angle, according to diameter of mill, and the "radial" or "end" teeth are cleared with a 15 degree angle cutter. "These angles are not always quite right, but we want to know when we have a mill to recut or replace what the angles were without measuring them, so we just keep them uniform," said the foreman of the mill-makers, and his reasoning was good, and all the disputed points of the best angle for mill tooth face which were so vigorously debated by the old tool makers have passed from view completely.

Inserted tooth mills are commonly made with machine steel bodies.

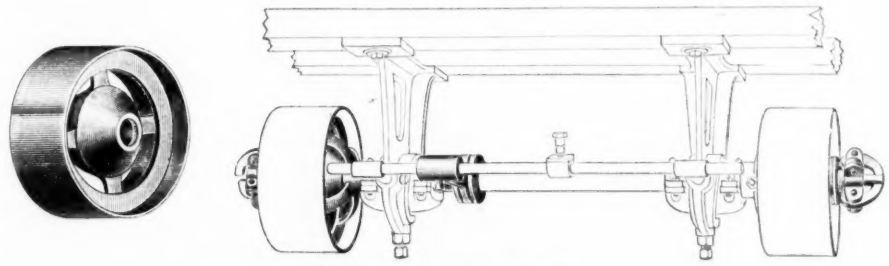
Figs. 17 and 18 show inserted tooth mills, with keyways in the arbor hole, and the teeth held endwise by screws, tapped in the body below the mill cuts made for the dovetailed inserted teeth, and having the heads of the screws bear against shoulders formed in the ends of the mill teeth, so that the overhanging ends of the mill teeth could make radial cuts without having the screw heads interfere with the work. At one end of the mill body these screws are screwed down hard on the body; at the other end the body is countersunk for the heads, so that the head of the screw bears on the end of the mill tooth. Figs 23 and 24 show a mill of the same general construction, having solid driving lugs formed on the mill body. This dovetail inserted tooth mill is costly. It takes two cuts through each tooth seat to produce the dovetail in the head, and it is a very difficult matter to make the dovetail seats alike; it is also expensive to make the taper-sided teeth to fit the dovetail, and as they must be closely fitted, it is an easy matter to split one of the dividing walls out of the mill body by driving the tooth too tight; they are efficient tools when well made, but nobody ever said they were cheap.

Figs. 19, 20, 21 and 22 show inserted teeth, with parallel sides put in straight radial cuts in the mill bodies; these cuts are each one simple mill cut, and hence are made to size without much difficulty, and the tooth stock is also rectangular in section, and consequently easily produced; these teeth are not fitted at all; they are simply machined to an easy sliding fit in the body grooves; between the body grooves, about midway of the depth of the tooth cuts in the mill body taper holes are reamed to fit a suitably-sized taper pin, such as are sold at astonishingly low prices by some of the machine screw makers; then narrow cuts are milled down through the middle of these taper holes, the teeth are slipped in, a taper pin is driven into the taper hole in the mill body, and the mill is made ready to turn up and bevel the teeth. This simple device of the taper pin key greatly reduces the cost of the mill, and holds the teeth firmly at any point where they may be placed in the tooth seat, so that they can be moved out endwise as they wear away, and is in every way perfectly satisfactory. This style of mill originated in the Pratt & Whitney shops, and an application for patent is now pending for it.

Fig. 25 shows a large mill in perspective, and Fig. 26 the construction of the same in section. The outside diameter of the cutter circle is 10″. The body is threaded internally to go on the spindle nose, which is 5″ diameter at the largest part, and this body is also threaded externally to take a backing ring against which all the inner ends of the teeth abut; the front part of the body is enlarged, and in this enlarged part the tooth seats are cut at an angle of 19 degrees, as shown in the partial front view, Fig. 27, and this enlarged part is also drilled and tapped for a holding screw against each cutter. This gives a cutter face angle of 19 degrees. The mill is used for squaring an end of a mild steel bar. A steel ring bored to fit the outer enlarged part of the mill body is slipped over the inserted teeth, and both the teeth and ring are held in place by the tool holding screws. This is a late production.

Fig. 28 is a perspective of the mate to this mill, for squaring off the other end of the same bar at the same time, and this mill is yet more complex in structure, having two sets of teeth, one outside of the other, either of which may be used at will while the other is idle, the idea being to use one for roughing, and the other for finishing accurately the 16 foot bars to gauge length.

Figs. 29 and 30 show a section and outer end construction. The body is formed with an enlarged outer part, as before, in which the seats for the inner circle of teeth are milled, and the teeth are held with screws from the inside, as in the first example; over these tooth seats a ring is keyed, which extends some distance to the rear beyond the tooth seated part, and the rear end of this ring is threaded both outside and inside; on the inside a backing ring for the inside ring of cutters is threaded, this ring having clamping sections for clamping the ring in position on the inside screw thread, as shown at the top of the sectional view. On the outside of the keyed ring at the rear end is threaded the backing ring for the outside row of cutters; this ring has spanner holes opening on the outside, and also a T-groove in the front face, fitted with T segment nuts, as shown, which segment nuts take the rear end of screws seated in a fourth ring which surrounds the double threaded ring, so that turning the third ring with a spanner will draw this fourth ring back and forth; the third ring is also provided with clamping sections and screws the same as the internal backing ring; the fourth ring has internal cutter seats milled in it, for the outer ring of cutters, each cutter seat having a headless screw tapped into it from the outside, these headless screws having tits on their inside ends which enter one of a series of holes in the outer sides of the outer cutters, as shown in the section; thus the outer row of cutters are held in place endwise in the fourth ring by the tits of the headless screws tapped through the fourth ring from the outside, and the fourth ring is held in place endwise by the screws passed through it from front to rear, and tapped into the segment nuts which slide in the T-groove in the front face of the third ring, so that by turning the third ring the whole outer circle of cutters may be advanced beyond the inside circle of cutters, or drawn back behind them, so that either circle of cutters may be brought into operation as desired. These two last examples show conclusively that cutters or mills are given what are thought to be desirable features regardless of precedent and cost. I did not see these mills at work, but they are undoubtedly efficient tools for their purpose, and they are certainly remarkable exhibits of development from the simple solid mill.



FRICTION COUNTERSHAFT.

Friction Countershaft.

The accompanying illustration represents a friction countershaft which differs in several important particulars from the usual form.

The shaft is hollow, threaded at both ends for the adjustable clamp collars which hold the fingers, thus bringing the adjusting points outside of pulleys and hangers, and adding much to the convenience of making adjustments.

Passing through the center of the shaft is the shipper rod, the projecting ends of which act upon the fingers in the manner indicated, longitudinal motion being given to the shipper rod by means of the usual slip collar and fork, the collar being connected to the rod by a pin passing through a slot in the shaft which permits endwise movement.

The friction surfaces are radial, and as near the face of the pulley as possible, that on the pulley having cemented to it a prepared paper pad.

Both the boxes and the pulleys are provided with reservoirs for oil, and special means for circulating it over the bearings, and thus maintaining thorough lubrication.

Placing the pulleys outside of the hangers permits the belts to be slipped off without unlacing. A pulley is shown detached from the countershaft. The countershafts are made and adapted to all kinds of service by the States Machine Company, Hartford, Conn.

Condition and Prospect of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

(Continued from last week.)

Jones & Lamson Machine Co. (Turret Machinery, Flat Turret Lathes, Screw Machines and Turret Lathes, Complete Outfit of Turret Tools), Springfield, Vt., write us:

An indicator card taken from our business of this year would show some wild fluctuations; but the mean effective pressure as represented by the total sales would be greater than that of any previous year.

We have built a new shop adjoining the old shop, giving us an additional floor space twice our previous area; in addition to this have added many new machine tools of regular and special design for the more accurate and economical production of our specialty, the flat turret lathe. This machine has gained in favor and we are now printing a list of over 200 running machines; 100 have been sold during the present year.

We have made no change in our selling or labor prices. For each of the months of October and November we received orders equal to 90 per cent. of the monthly average of the year 1892. This to us is encouraging, and on it we base our hope of a general improvement in the times.

John Wiley & Sons (Publishers of Scientific Text-books and Industrial Works), New York, write us:

Contrary to our expectations, our business has not been materially affected by the "hard times," but has shown some improvement.

This seems to show that men engaged in industrial pursuits use their leisure time for reading in the line of their occupations.

We continue to find the AMERICAN MACHINIST a valuable advertising medium and shall keep using it until further notice.

Clayton Air Compressor Works, 43 Dey street, New York, write us:

Working full time and full capacity, and behind on their deliveries, is the gratifying report furnished by the Clayton Air Compressor Works of 43 Dey street, New York, as to their shops in Brooklyn.

In the prevailing business depression this speaks volumes for the excellence of the air compressors built by this company. They have recently taken out several valuable patents on a new triple compound high-pressure air or gas compressor used largely by manufacturers of carbonic acid gas.

The Egan Company (Wood-working Machinery), Cincinnati, O., write us:

Our business up to about July 1, 1893, was entirely satisfactory and at a rate that would be proven to have been the best year in the history of this company. The following three months were as quiet as the

stillness of the night. From October until now we are running quite largely on orders from abroad and South America, and in fact we would have been unable to run at all were it not for these foreign orders. We are glad that we worked so many years for this foreign trade. The domestic trade is looking up a little and we hope that a continuance of the same will ensue The tariff question causes uneasiness and may result in more conservatism. Labor, products and materials are all lower. The year 1894 is in the future; who can say what it will be?

Warner & Swasey (Designers and Manufacturers of Machine Tools and Special Machinery), Cleveland, O., write us:

Since we last wrote you we have put in a complete new power plant with a view to the extension of our works, and have also added to our equipment several new machine tools.

During the year we have added several new machine tools to our catalogue, so that now our line of brass working tools and revolving turret screw machines is practically complete.

Although our machine tool business for the last half of the year has been below the average yet our exhibits at the World's Fair have resulted in a marked increase in our foreign orders, and thus far we have been able to run full time with nearly our full force of workmen.

The Billings & Spencer Co. (Machinists' Tools and Drop Forgings), Hartford, Conn., write us:

The amount of our business for the first six months of the year 1893 equals the amount of that of 1892. For the past six months it has fallen off 50 per cent. We have received this month (December) some large orders for our Billings' bicycle wrenches and drop forgings for bicycles for the coming season, also for Billings' patent drop-forged computator bars for dynamo electric motors, which will keep us quite busy for the next sixty days. Beyond that time what the future has in store we are unable to state.

J. A. Fay & Co. (Wood-working Machinery), Cincinnati, O , write us:

The year 1893 will be a remarkable one for all manufacturers. The "object lesson" was one of severity. The fore part of the year was unusual in the disposition of machinery and the result was pleasing. The summer months were blighting indeed, no business whatever. The last two months were improvements and we trust will continue.

Congress with its menacing attitude induces lack of confidence, hence, until something definite is reached, we think that there will be no pronounced advance Labor is lower, likewise material; prices of machines are not what they should be. As to 1894 it is only a guess.

The Dwight Slate Machine Co. (Manufacturers of Machinery and Tools), Hartford, Conn., write us:

The beginning of the year 1893 found our shop full of work and about 70 hands on our pay roll. We kept this number employed until about July 1st, and since then orders for tools in our line have fallen off fully 50 per cent. To accommodate special work taken at that time we made quite an addition to our plant and have been able to keep the greater portion of our help employed on this class of work. Have applied successfully a new feed to the Gatling gun, and in the line of labor-saving machinery have built some complicated thread winding machines, and attachments to printing press for counting and banding postal cards.

Have added to our regular product a new automatic gear cutter, small tapping machine, special axle milling machine, a twelve-spindle gang drill and other tools.

Price of labor of the better class has not been reduced. The lower grades of labor reduced 10 to 15 per cent.

We are now running nine hours per day with about two-thirds regular force. While hopeful, we do not look for improvement in business until the tariff question is settled in a manner that shall show some signs of permanence and stability.

Penberthy Injector Co. (Improved Automatic Injector and other Steam Specialties), Detroit, Mich., write us:

Would say that 1893 has been, in the main, a prosperous year with us. Up to August 1st, our business was very largely in excess of last year, but from that date to the first of November, owing to the financial panic, orders were very light, and while we were not compelled to shut down our factory, we reduced our force about one-third during that time. Since the first of November business has increased to such an extent that we have felt justified in putting on our old force and are now running our factory on full time, and expect to do so for the remainder of the winter.

As to the prospects for 1894, would say that we do not anticipate so large a trade during the early months of the year as we had in 1893, but we are hoping for a steady increase of business from now on. We are taking contracts from traction engine manufacturers, and while these are not so heavy as the same contracts which were taken last year, yet they show that business is very far from being at a standstill in that line.

In addition to the firms whose orders we usually receive, we are gratified to be able to say that we are receiving contracts this year from several new firms.

Very early in the present year we found our factory too small for the amount of work that we were required to turn out. We therefore enlarged it to nearly double its former size, putting in at the same time 12 new speed and monitor lathes, as well as other improved machinery. Just as we had our improvements completed, we were so unfortunate as to have the entire third floor of our factory destroyed by fire. This compelled us to be idle for several weeks at the busiest time of the year, but all damages were repaired as quickly as possible. Since that time no misfortunes have befallen us to interfere with our running continuously. There have been some improvements made in methods of working up our material, but the saving effected by these changes has been fully off set by the reduced price at which the injector has been sold. Altogether the year has been a very satisfactory one, and we hope that the year to come will not be less so.

John L. Kelley (Kelley's Patent Specialties), Erie, Pa., writes us:

As to the past, present and future outlook of my business, will say I have been out among my customers for the past three months, and think I can give you a fair opinion of the condition of business in general as I found it. The results for the future are so uncertain that there is no vitality in business. Customers with whom in former years I have been able to make yearly contracts for their yearly supply, this year can give me no promise for the future. It is needless for me to say that the agitation of the tariff question is the most potent cause for the depressed condition of business; therefore you will see that the outlook is not bright. My business for the past year has only been fair. I have added no new tools, only some especially designed for the manufacture of my specialties, which I have done in order to meet the demand for declining prices which rules the business of the country at present. Up to the present date my shop has run 200 days since January 1, 1893, with half the complement of help There has been no material change in the price of labor the past year. I have added one new article of production, in a new gauge cock, which I will have ready for market (if there is any) by the first of the year. The past has been but fair, the present is bad, and from present indications, the outlook for the coming year is poor.

Builders Iron Foundry (Founders and Machinists) Providence, R. I., write us:

The condition of our business during 1893 on the whole has been satisfactory.

Our foundry (20,000 square feet molding floors) was crowded until the end of August, and during the summer we were obliged to hire a small foundry near us, and to have castings made by other founders in the city. Since September 1st. the number of molders has been reduced, and on Saturdays, as a rule, we have run only our "baby cupola."

The decrease in orders is chiefly due to dullness in the business of customers for chilled iron castings, engine castings, machinery castings and castings for large electrical apparatus. Sales of architectural iron work and globe special castings for water works have been larger than usual.

In our machine shops (about 30,000 square feet floor space) business has continued good throughout the year. All large tools have run day and night, the pressure being for the 16 ton 12-inch breech loading rifled mortars and mountings required by the United States Government.

There has been no enlargement of our works except an extension of the ware-room, fitted with two 10 ton hand traveling cranes, and six 2 ton wall cranes. One of the foundry cranes has been altered from 20 to 25 tons capacity, and changed from a rope driven to an electrical crane, making it similar to its mate in the gun room, which was altered last year. Five tools have been added in the machine shop.

Our most important and interesting novelty is the Venturi water meter. One of these, a 6 inch meter, measured the supply of drinking water at the World's Columbian Exposition, and a 36 inch meter measured the main water supply. The 48 inch meter at the Macopin in-take of the East Jersey Water Company has registered 2,727,000,000 gallons of water since its installment, the 1st. of August.

With the spring we look for ordinarily good business in the foundry, and for at least three months our machine shops will continue to run night and day.

L. S. Starrett (Fine Mechanical Tools), Athol, Mass., writes us:

Up to the 1st of June we were behind orders, having more than we could do, but since that time orders have dwindled down, until I have had to let many of my help go; nevertheless, as I had contracted to have built a three-story and basement building, 160x40 feet, and an annex brick building, 70x44 feet for engine house, etc., I have carried them through to completion, taking advantage of the dull times to prepare for good times when they come.

These buildings are heavily timbered and finished in A1 shape with all modern improvements, and are now about ready for the reception of machinery. A 110 horse-power wheel, and a 100 horse-power engine have been put in to furnish the additional power.

I have during the past year interested myself in the manufacture of milling cutters, forming tools, slitting saws, etc , with Mr. F. J. Gay, formerly superintendent of this branch of business for the Brown & Sharpe Mfg Co., and now with advanced ideas of his own, we shall endeavor to lead in this line of business.

I have also during the year added to my line of fine tools an improved speed indicator, adjustable jaw cut nipper, a line of firm joint calipers, new surface gauges, flat steel squares, etc., all of which will be shown up in my 1894 catalogue of 86 pages now in the printer's hands.

Foster Engineering Co. (Pressure Regulators for Steam, Water, Gas and Air), Newark, N. J., write us:

First of all we desire to say that we regard the AMERICAN MACHINIST as one of the very best engineering and trade journals that comes to our office. Our superintendent and most intelligent workmen find it invaluable for the information and suggestions it contains, and we circulate the copies we receive freely among them. From the office point of view we can also say that our advertisements in its columns have brought us quick and good returns, which we are glad of this opportunity to acknowledge.

As to our business during 1893, we consider ourselves exceptionally fortunate. Factories and mills all around us have been closed, either in whole or in part, since July and August last, thus greatly reducing their pay-rolls and product; while we, on the other hand, with the exception of two or three weeks in the summer, have run our works on full time, paid full wages to all hands, and done a good business. Better than this, instead of closing our doors and reducing our working force, we have more than doubled the number of our hands, and largely added to our plant and facilities by installing large machines and hundreds of special tools for the manufacture of our own regulators, and doing contract work for others in all steam specialties.

Our prosperity has been largely due to the awakened activity in ship-building generally, and to the large demand for our valves from the leading railroads of the country. This has kept the marine and railroad branches of our business on the jump. The patriotic purpose of our Government to build a new navy, resulting in the construction of such vessels as the peerless "New York" and "Columbia," and all the other cruisers and battleships lately built, has brought grist to our mill. All these Government vessels have been fully fitted out with our regulators. In fact, the Foster pressure regulator is the standard of the U. S. Navy. You will readily understand that on ship-board it is absolutely essential that not a pound of steam be wasted, but that all that can be spared from the service of the many auxiliary engines should be utilized for the purpose of speed. This requirement the "Foster" valve meets to perfection, and it is not too much to say that the phenomenal speed which has made our cruisers the record makers and breakers of the world, has largely been attained, amongst other things, through the perfect operation of our valves. The same is true on all steamers though perhaps to a less exacting degree than in the Government service. Our valve is in use on thousands of ocean, sound and lake steamers, as well as on tugs, yachts, ferry-boats, river, passenger and freight vessels, and in the coastwise traffic.

In the railroad branch of our business, in addition to equipping several of the large trunk lines with the Foster valve for the steam heating of trains, we manufacture an inside safety check for locomotive boilers, which is an invaluable safe-guard against loss of life and property in the case of collisions and other accidents which break off feed-water connections. Over 3 000 of these are in use on the Pennsylvania Railroad, and many other roads have applied and are applying them right along.

The demand for our valves for export to Cuba and the Central and South American States, under the operation of the reciprocity treaties, has in the past been very large. It has fallen off lately, owing to the uncertainty of future trade relations with those countries.

We wish we could report like activity all along the line, but regret to say that the large business we have done with the general industries, has fallen off since the summer of 1893. Our valve is in use and in demand in many of the large breweries, paper mills, steel and iron mills, electric lighting plants, rubber works, dye works, woolen and cotton mills, and in all textile manufactories, wherever, in fact, it is desired to deliver a uniform lower pressure from a given higher initial pressure of steam, water, gas or air.

For the steam-heating of office, public and private buildings, and for water works and other improvements in the larger and smaller cities, our valve is still in steady demand.

In conclusion, we will say that the depression in business, which we all deplore, has, of course, affected us materially. We look hopefully for a resumption of the normal condition of things, as soon as legislation touching the tariff shall be settled on a fair and equitable basis. This is our reply to your inquiry concerning our judgment of the outlook for 1894. Settle the tariff on the lines of American interests—for the wage-earner and the manufacturer alike—and we shall soon see the closed doors opened again, hundreds of thousands of discharged workmen returning to their tools and benches, the music of the hammer and wheel again filling the air, and the smile of contentment on millions of happy faces that are now darkened by the cloud of disappointment and dread, if not of despair.

Passaic Art Casting Co. (Fine Castings in Bronze, Brass, German Silver, Aluminum and Other Metals), Passaic, N. J., write us:

Our business has suffered in common with all others during the greater part of this year. At this time last year our factory was running with 40 men, now there are only 10. Then there was a brisk demand in both the lines in which we are chiefly engaged; first, artistic castings for fancy metal goods, things of beauty and luxury; and second, fine machinery name plates. Now in both these lines business is almost nothing. We keep running, however, on small jobbing orders for fine castings in brass and aluminum for an increasing number of customers, as the merit of our patent processes becomes better known. We have no hope of any revival in business until after Congress settles the tariff question one way or the other. We have reduced wages about 10 per cent. cost of raw material, metal has declined about 20 per cent., coal is higher than last year. Selling price of product remains the same and profits are less, notwithstanding the reduction in cost; for fixed expenses, as taxes, insurance, water, rent, interests, fuel, etc., on a smaller product make a greater increase in total costs.

The J. M. Carpenter Tap and Die Co., Successors to J. M. Carpenter (Taps, Dies, Reamers, Screw Plates, Die Stocks, Tap Wrenches, etc.), Pawtucket, R. I., write us:

Business with us at the present time, as with a good many others, is not what might be called good, but we have not ceased in our efforts to put on the market the best quality of taps and dies of all descriptions, fitting the exact wants of the trade. We have added to our already very complete list of patent adjustable stocks and dies new sets especially adapted for bicycle work, which will appear in our circular.

We believe we see business prospects improving, which will be influenced more or less by the way Congress deals with tariff legislation.

American Gas Furnace Company, 80 Nassau street, New York, write us:

We are somewhat ahead in our sales as compared with 1892 but have so far seen less cash for them, collections during the last half of the year being very slow indeed. Since we depend for our orders almost entirely upon the willingness of manufacturers to improve their working facilities at considerable expense, and considering that the general condition of business was strongly against such improvements, we cannot help feeling gratified and encouraged by the gain, though small, which we have made over the sales of 1892. Part of this gain is due to a demand for our gas blast furnaces and high-pressure blowers in England and

Germany, where they have found much appreciation and a constantly growing market.

Our factory having been inadequate for last year's work the plant was greatly enlarged and improved during the first half of this year, and further additions to working facilities are contemplated as soon as our "sound currency" circulates a little more freely than now in our *immediate* vicinity, but we are even now prepared to meet the confidently expected material increase of business.

The early settlement of the tariff question is now our daily prayer, believing that the "schedules" and "rates" are of greatly less importance than the removal of uncertainty. Confident that no real harm can come to live, progressive American manufacturers and mechanics from the deliberate action of a majority of their fellow citizens, we ourselves feel perfectly confident of a prosperous New Year, and heartily wish it for the AMERICAN MACHINIST and all its readers.

Standard Tool Co. (Manufacturers of Fine Machinist Tools), Athol, Mass., write us:

The year just closing so disastrously to many in the business world opened for us with the brightest and fairest of prospects, and for the first six months it was one continuous boom. We were again, as in 1892, obliged to add new tools and machinery. We heard the mutterings of the financial cyclone as it swept over the West, but it did not strike us until about July 1st. But like good sailors we had all hands on deck, and at once shortened sail, headed her into the wind, and let her drift. Since July we have been doing fully 50 per cent. of the business of 1892. The prospects for 1894 are so shrouded in the mists of uncertainty that we are simply watching and waiting for that sweet by-and by. We have not reduced the wages of our employes; in fact, have not felt the necessity for doing so. We believe it poor policy to cut the pay of the laboring people, as it deprives them of the purchasing power, and so reacts upon the manufacturer. Prices of our products remain about the same as our former quotation. As to material used, it seems to be catch as catch can. We know that dull trade in machinist fine tools is not due to a lack of confidence in quality, material, or substantial worth of any goods produced by the Standard Tool Co., of Athol, and that the AMERICAN MACHINIST as an advertising medium has distanced all competitors, and is the one bright particular star in the mechanical advertising world.

Fitchburg Machine Works (Metal Working Machinery), Fitchburg, Mass., write us:

Our progress for 1893 and present condition can be told in a very few words, and is the same as told of nearly all the manufacturing interests in the country, full reports of which are daily found in the newspapers.

Very early in the year we felt the change in business brought about by the change of the party in power. It was very soon demonstrated that there was a good reason for the lack of confidence displayed by nearly every business man in the country. We were fortunate in having a very good business the first six months of the year; since that time we have in common with others found nearly every kind of business very quiet.

As a natural consequence, competition has been very sharp, and some manufacturers show a disposition to sell regardless of cost.

Under these circumstances there is not much encouragement to spend money in improvements, but we have faith to believe that some day the tide will turn, and although we have not made any radical changes or brought out any new tools in the past year, we have taken advantage of the quiet times, and have been able to make many improvements in construction and in methods.

We do not look for any particular improvement until the tariff question is settled, and if the proposed bill becomes a law the only result possible will be less business, and lower prices for product and for labor.

The National Machinery Co. (Bolt and Nut Machinery), Tiffin, O., write us:

Trade with us for the first half of 1893 was fully up to our expectations, and we can say equaled that of the same period of 1892. During the last half of the year our business was exceedingly brisk, considering the excessive dullness that has existed throughout the country for the last six months.

As regards the prospects for 1894, while at the present time everything indicates that the volume of business among the manufacturers of the United States, especially the manufacturers of machinery, will not compare very favorably with that of the past year, still it is very difficult to state anything definite. We are, however, of the opinion that if confidence can be restored matters will at once assume a much brighter aspect. There has been no special change in the cost of labor and material, or the figures we have been receiving for our products.

We would further state that our company was entirely reorganized during the early part of 1893, capital greatly enlarged, and extensive additions made to our works, and we consider we are in better condition to construct and furnish bolt, nut, forging, upsetting and similar lines of tools than ever before, and we also contemplate still further extensions to our plant the early part of the coming season to enable us to keep pace with the numerous orders received for the national rock and ore crusher, which is commanding the attention of manufacturers of crushed stone or macadam and producers of ore.

We would also mention we were awarded the first medals at the World's Columbian Exposition on bolt-heading, bolt-threading and nut-tapping machinery, which substantiates our claims of superiority.

Hugo Bilgram, Successor to Brehmer Bros. (Maker of Special Machinery, Sole Manufacturer of the Heyl & Brehmer Patent Wire Book Sewing Machine), Philadelphia, Pa., writes:

During the first half of the current year I was employed to the limits of my capacity, but during the summer and fall months work fell off considerably, and had it not been that I had an order for machines to be sent abroad my business would have been practically at a standstill. This work has fortunately kept me quite busy.

The prospects for the coming year are decidedly uncertain. There are some signs of a possible revival.

The fact that domestic work has been excessively dull, and that work for abroad alone has kept me busy, strengthens my conviction that the tariff question plays no part in the problem of national prosperity, while the difficulty experienced in making collections tends to confirm my opinion that the insufficiency of an efficient medium of exchange is the direct cause of the present business stagnation.

The George Burnham Co. (Patent Improved Drills, Hand or Power, also Clamp Drills), Worcester, Mass., write us:

The year started in with brilliant prospects and trade was unusually good till the panic struck us, so I will have the curious spectacle of the largest and smallest months' trade in the history of the business. This year I have added to my plant one 23 inch engine lathe and one 25 inch Snyder upright drill. This year and some time the ensuing year I will put in a new planer. The prospects for 1894 are rather uncertain, and until I can see some settled conditions of business I shall make no plans very far ahead. There has been no change in prices on labor or material.

Chas. A. Strelinger & Co. (Hardware, Tools and Supplies, Machinery), Detroit, Mich., write us:

Your favor of 9th at hand, and in reply would say that our business up to the first of July of this year was uncommonly good. Since that time, like a great many others, we have had some set-backs, but on the whole, we console ourselves with the thought that it might have been worse.

Up to the past six weeks it was almost impossible to make collections, but since that time there has been quite an improvement in this respect.

However, "Every cloud has a silver lining," and the general dullness in business has given us ample opportunity to prepare our new catalogue. We have issued a number of catalogues, but they have not differed materially from the general run of publications of this sort. The catalogue we are preparing now will contain from 450 to 500 pages, and we hope to present a great many new features that will be especially desirable both to manufacturers and mechanics.

We are constrained to believe that every mechanic who reads the AMERICAN MACHINIST will want one of our books. We hope to have them out in about sixty days, and will take pleasure in sending you a copy for inspection and criticism.

Crescent Steel Co., Pittsburgh, Pa., write us:

The first six months were quite satisfactory, but in common with most other kinds of business, our orders have somewhat fallen off of late. Prices for the fine grades of tool and die steel have ruled quite steady, and as a fact, there is not much chance for variation where such fine and high priced stock is used as we put into our products. There has been great pressure for lower prices, as is expected in the present condition of affairs, but the continued test of much of the low-priced tool steel sold has proved to many consumers that there are several cheaper things than low-priced tool steel when the cost of keeping up tools is considered. Our plant is thoroughly equipped and in good condition to meet a rapid and permanent improvement in business, and with a continued use of the highest grades of iron used in steel-making, there can be little or no reduction in selling price, but our customers can rest assured that we will furnish steel second to none made anywhere, and which will show results that cannot fail to encourage the use of the best grades of steel.

The Connersville Blower Co. (Rotary Positive Pressure Blowers, Gas Exhausters, Pumps, Motors, etc.), Connersville, Ind., write us:

Inasmuch as this enterprise was inaugurated only last summer, we are not in a position to make comparisons with previous years. However, taking into consideration the depressed state of business generally, the trade we have enjoyed has been quite satisfactory indeed, and, forming our opinion from the orders that are being placed and the number of inquiries we are receiving, we are inclined to take a hopeful view of the future. Of course, we have not lost sight of the fact that we have entered the field with what we believe to be an improved blower, for which there is a rather steady demand.

Leland, Faulconer & Norton Co. (Machinery and Tools), Detroit, Mich., write us:

We beg to report that our business during the year now coming to a close has been on the whole quite satisfactory. In common with all other manufacturers, we have suffered during the past six months from the depression of the times.

About the first of May we moved into our new works, and have about four times the shop room that we had last year. We have been running constantly on full time, and with our usual force.

We can hardly hope for any great increase of business in the immediate future, although the prospects are not as dark and dreary as they might be.

The Cincinnati Milling Machine Co. (Fine Machine Tools), Cincinnati O., write us:

Our sales fell short of 1892, but we have been able to operate our works the entire year with the exception of several weeks. Our export shipments for the year show quite an improvement. The prices of labor and material are somewhat reduced. Having greatly enlarged our facilities in 1892, we do not need to enlarge our works until trade greatly improves.

During the year we have made some improvements in our milling machines, also have added two new features, viz., circular and surface grinding, to our universal cutter and tool grinder.

L. E. Hoyt & Co. (General Founders and Machinists), Walton, N. Y., write us:

Our business for the year 1893 started strong enough to lead us to enlarge our foundry, replace our old cupola with a larger one and improve our foundry facilities generally. We have felt the business depression quite severely, perhaps a little more severely on account of several of our lines coming under the head of our touching the luxuries.

Our *water motors* and fine castings have sustained themselves and have kept on making a reputation through it all, which makes us think that our efforts in this line are appreciated. Our prices remained about the same, with the exception of the prices on castings, which we have considerably reduced.

We have been obliged to make a slight reduction in wages all around, to meet the shortage of sales and general depression, but business at present seems to show a growing firmness, and we think the outlook much more favorable than it has been for some time.

Armstrong Bros. Tool Co. (Armstrong Tool Holder for General Lathe and Planer Work), Chicago, Ill., write us:

During the year 1893 we have entered many new customers in our books, and have had a very good run of business. When we started to make our tool holders we expected to find a great deal of prejudice against a tool of this kind, and we were not disappointed. But on the whole we think we have reason to congratulate ourselves on the success we have met with. We have now sent out over 10,000 tools, many of which were on trial, and with the exception of one case, where the parties put a ⅝ inch tool in a 36 inch lathe, all have stayed and are giving good satisfaction. We have 500 testimonial letters, and have sold as many as 150 tools to one firm. During the past year we have built a new shop, and have added several special machines. We have also added to our list two large sizes of our tool holder, also one small size put up in a hardwood case with nine cutters. We are now working on, and expect to have on the market soon, a new boring tool holder which will use self hardening steel cutters, same as our turning tools. We have tested this tool thoroughly, and we think it will be as great a success as our other tools. We have been helped a great deal by our advertisement in the AMERICAN MACHINIST, having sold many tools in Canada, England, France and Germany directly through it.

Stover Novelty Works (Wood and Iron Working Machinery), Freeport, Ill., write us:

In regard to our business progress during 1893, and the prospects for 1894, would say our business since last spring has been practically at a standstill, but since the first of December it has been gradually picking up, and the prospects for the future are very bright.

While our business has been dull, our minds have been busily engaged in developing new machinery. We are very enthusiastic over our several new drills, especially our turret drill, which we think promises a bright future.

Our facilities now enable us to fill orders to the satisfaction of our patrons.

Norton Emery Wheel Co. (Worcester, Mass., write us:

The total amount of business for the first six months of the present year showed a large percentage of increase over the corresponding months of last year or any previous year, and gave us sufficient encouragement, so that we increased our facilities before July 1st something over 50 per cent. Business began to fall off somewhat in July, and more in August and September, the latter being our lightest month, since which time it has been steadily improving.

The total amount of business in the lightest month was about half what it would have been ordinarily, and now we are doing about two-thirds of the regular amount.

We expected that December business would be very light on account of its being the close of the year, but it is better than anticipated, and from the orders and correspondence, and personal investigation, we learn that a great many of the consumers and jobbers must be nearly out of emery wheels, and we shall be disappointed if business does not improve in a marked degree after January 1st. Our mails have been just as large as usual through all the depression, and we have about as much office work to do as ever, there being about as many motions to go through, the falling off being in the size of the orders.

Boston Gear Works (Gear Wheels and Cutting of Every Description), Boston, Mass.), write us:

Although there has been considerable falling off in trade during the last five or six months, yet we have no cause to complain, as we have been running our shop on full time, with the exception of a few weeks, and we have had orders enough the last few months to keep us quite busy. We look forward to a fair trade in 1894.

During the past year we have increased our facilities for heavy gearing, and are prepared to furnish cut gears not exceeding 7 feet in diameter of any pitch. We are pleased to state that we are now able, with improved apparatus, to furnish large internal gears of any pitch, and if made in quantities, they will compare favorably in price with spur gears.

We have just issued a supplementary sheet to our catalogue. This is ready for distribution, and contains an additional list of iron gears, chains, steel balls for bearings and cutters.

We expect to have our 1894 catalogue ready by March 30th. Applications received before that time will be placed on file and catalogues sent as soon as issued.

Sebastian Lathe Co. (Improved Engine and Speed Lathes, Machinists' Tools and Supplies), Cincinnati, O., write us:

In common with others, we presume, we have suffered somewhat from the general depression in business during the past few months, but taking the year as a whole, we have no great reason to complain. During the first half of the year we were crowded with orders, and obtained very satisfactory prices; during the latter half of the year we think that we obtained our share of the limited amount of business that was done; consequently, as stated above, we are not complaining.

During the recent depression we have taken the opportunity to overhaul all our patterns and designs, and will be ready with the New Year to offer a line of engine lathes that will be right up in the front rank of the best tools on the market, and your

editorial in this week's issue confirms our belief that there will be a strong demand for just such tools. Just now prices are perhaps a little lower, or rather we are disposed to cut our prices somewhat to catch orders, but we can see no reason why they should be reduced for the coming year or after business has resumed its normal condition. We are not getting material any cheaper, nor have we found it necessary or desirable to reduce the wages of our employes.

The main thing now is to get business into active operation; that done, we believe the present depression will very soon be a thing of the past and forgotten in the general prosperity which we look forward to enjoying in the coming year.

Robert J. Stuart's Foundry and Machine Works (All Kinds of Machinery and First-class Castings, Experimental and New Machinery), New Hamburgh, N. Y., write us:

Would say that business for the past year has on the whole been very satisfactory. While we have not been crowded with orders, we have been able to keep our usual force of men on full time. Prices are a little lower than in 1892, but wages have remained the same.

The demand for our compression wedge couplings increases; users appreciate the privilege of returning them at our expense if they fail to give entire satisfaction. We have also done a satisfactory business in light steel cars used for conveying brick, tile, terra cotta, lumber, starch, etc., to drying kilns. Are now finishing up some good-sized orders. The outlook for the near future, in our estimation, depends much on the action taken by Congress on the tariff question. If they defeat the Wilson bill and all measures bordering so close to free trade I think the appeals for charity will lessen and the demands for honest labor increase.

New Doty Manufacturing Co. (Hand and Belt Power Punching and Shearing Machines), Janesville, Wis., write us:

Our business for the first six months of 1893 was 25 per cent. ahead of any other six months since we have been in business. When the hard times came on our business dropped off to nearly nothing. It has picked up a little during the past month, but is still far from satisfactory. We do not look forward to much business during the coming winter, as we think the recovery will be slow. We made some improvements in our plant, principally by the addition of new tools during early part of year. Collections of late have been slow and we have had some losses from failures, etc.

The Burton Machine Co. (The Erie Key-seating Machine, etc.), Erie, Pa., write us:

Business with us has been extremely quiet since last August, and we do not see any immediate prospect for improvement. We have made no enlargements, and no changes worth mentioning.

Betts Machine Co. (Metal Working Machine Tools for Railway, Bridge and Machine Shops, and Iron Works generally), Wilmington, Del., write us:

The volume of our business for the year 1893 has not been up to the average. Trade, at this writing, is dull and depressed, prices unsettled, tending downward, and prospect for the future uncertain. We do not contemplate any enlargement of plant while trade is in the present unsettled condition.

Randolph Brandt (Selden Patent Packing, with and without Rubber Core, Mine, Mill and Steamship Supplies), New York, writes us:

Up to July 1st sales of "Selden Packing" and engineers' supplies were ahead of the same period in '92. July, August and September were such as to try the faith of old timers in sales and collections, since then a very satisfactory improvement in both, and I have every reason to believe that '94 will show up in good shape.

I have not changed rates of wages but have found my employes anxious to help in every way the "Old Man."

The Jones Bros. Electric Co. (Telegraph and Electrical Supplies), Cincinnati, O., write us:

Everybody seems to be croaking of hard times all over the country. 'Tis true collections are a little slow in coming in, and parties who are contemplating a push in their affairs hesitate in going ahead, but otherwise our business is just as good as it ever was; rather it is on the increase, for we have added to our light and power station another Porter engine and put in four Hawley furnaces under our boilers the past year, making one Corliss, one Beck and two Porter engines in use at the present time.

Our shop and foundry (employing 75 workmen) has been running full time the entire year, which goes to prove there is work to be had and to do if we make an effort to get it. We have taken up the manufacture of small articles in brass, steel and iron in addition to our model making department.

Our traveling salesmen continue to send us in orders for electrical supplies of all kinds, thus keeping the shipping clerks hustling, and our advice to all business firms in the machinery line is to advertise in the AMERICAN MACHINIST and other advertising mediums in order to keep your name before the country as live and prosperous establishments.

The E. Horton & Son Co. (The Horton Lathe Chuck), Windsor Locks, Conn., write us:

We will say that our business in common with others has felt the depression pervading all business circles. We have not been obliged to stop our works entirely; on the contrary, we have run our chuck shop 10 hours per day, all of the time, although with a greatly reduced force. The prospects of an increased business in the near future is not promising. We are doing as well as can be expected under the circumstances, and as compared to others engaged in the manufacture of iron working tools, we have no cause of complaint; we hold our place in the procession, and although the latter is going slow we expect it will get there some time, but probably not until this country decides upon some definite industrial policy.

The Weber Gas and Gasoline Engine Company, Kansas City, Mo., write us:

The year 1893 started out as a banner year for us. We were well booked with orders, and it was necessary to run night and day to keep up with same until about July 1st. Since that time we have been comfortably filled with orders until the 1st of December, when business slacked up somewhat. Prospects, however, for a large trade in the early spring are exceedingly bright, as indicated by fully 75 per cent. of our correspondents promising orders at that time. During the year we have increased our shop 50 per cent. by adding a large equipment of improved machine tools, and have plans in view for a still further increase next year if business justifies it. Prices of labor and material, with the exception of pig-iron, remain about the same, while the selling price of the product is considerably lower.

The "W. & S. Hydraulic Machinery Works," New York, write us:

We have made very few additions to our plant during the last year, but have done a good deal of overhauling. We have been compelled to bring out quite a number of new tools, and have more in prospect. The difficulty of making collections has been with us the unsatisfactory part of the year's business. The output from the shop has been very much in excess of that of last year, but at the present time there seems to be no prospect of new work, every one waiting for Congress to adjourn and stop monkeying with economic measures before deciding on new business.

W. P. Davis (Machine Tools, Engines and Boilers, etc.), Rochester, N. Y., writes us:

My business from January 1st to June 1st was excellent, but was principally in engines, boilers, shafting, hangers, pulleys and general supplies; business in machine tools has been very light for over a year. Since the 1st of June our manufacturing business has been exceedingly light, the poorest we have known for years, and our business at the store has fallen off nearly one-half. Still, all things considered, we feel well satisfied with our store trade.

Hundreds of men are out of employment, and a great many of the shops here are running on half-time, and I know of no manufacturing business here that is having a good business unless they manufacture some specialty.

For the last month there has been an improvement in correspondence and inquiries for machinery and supplies, although trade has not really increased much. I have no doubt if the tariff question is settled in a satisfactory manner business will improve very much soon after the first of the year.

I have quite a line of machine tools I build, but do not expect to bring out anything new, except I am now building a sensitive drill and an improved key seating machine.

In our issue of January 4, on page 2, the top line of fourth column should read: This rod operates a slide, etc.

Improved Breast Drill.

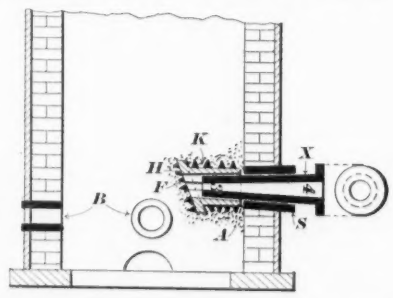
We illustrate herewith an improved breast drill, which, though made in the usual form, is designed to be superior to many of the breast drills usually made.

Its chuck will hold drills from the smallest size up to ½", and is well made with hardened steel jaws, which hold a drill accurately and securely, a feature which contributes to this being a lock for the gears, by which they are very readily prevented from turning when the chuck is loosened or tightened, thus preventing the use of nails, file tangs, etc., to block the teeth of the gears. The gears on this drill are cut, and material as well as workmanship are such as adapt it for its purpose. It is made by A. J. Wilkinson & Co., Boston, Mass.

New Side Center Blast Tuyere.

BY THOS. D. WEST.

In the accompanying cut is illustrated another plan I have designed for obtaining "center blast." As there are so many different designs of wind boxes or tuyere pipes carrying the blast to cupola tuyeres I show no device for attaching for wind connection to the sliding pipe X, but that is of second-



ary importance; a little inventive talent would soon arrange for that. The plan I herein present is simply to have two tapering pipes as seen at X and K, the taper to be about one inch in two feet, the latter having prickers cast on for holding a clay or refractory lining as shown, and when preparing the cupola insert X into the fixed sleeve S, and place K on over it, then stop or close up the joint between the walls of the cupola and K as seen at A, also close the inner joint as shown at F; and then before "dropping the bottom" pull back X so as to be cut free or clear of K and thus leave the latter free to drop with the bottom and should it not come down, a little prying on it through the opening S with a bar should cause it to drop. I would advise outside tuyeres being used in connection with this protruding side center blast tuyere, and which should be from 4 inches to 8 inches higher than outside tuyeres for the same reasons stated in my last articles for "Center Blast." For a 30-inch cupola I would advise the use of one protruding tuyere and above 40 inches diameter cupola two tuyeres, and above 60 inches three tuyeres, all to be 3 inch diameter at the smallest point or admittance of the blast, as shown in sketch. The taper of 1 inch to 2 feet being to permit the sleeve X to be readily removed; too much taper would be liable to let the prickered cap K work loose. Where more than one protruding tuyere is used I would not let them come together at the center by about 2 feet.

You cannot expect as even a distribution of the blast or quite as economical results by the plan here presented as by the bottom center tuyere shown in the November issue of the AMERICAN MACHINIST, but it offers a good chance to get at the tuyeres to keep them free and open, is in some respects not as liable to cause trouble and is in some other ways more desirable, and any one thinking the other device too burdensome to handle might take kindly to the plan herein presented, and which I give now freely to any that may wish to give it a trial, or adopt its use up to the close of the year, 1895, after that date I expect to control the device by a patent. It will be readily perceived that in the daily use of the protruding tuyeres here shown it would be essential to have two or three sets of K castings kept on hand, so that they could be daubed and dried and ready for use, as it would not do to attempt to daub them when in their position in the cupolas, a plan that could be adopted for the bottom center tuyere shown in November 2d issue of AMERICAN MACHINIST. B is to represent outside tuyeres and S a permanent fixture into which X can be readily inserted or removed.

The slanting face of K as shown at H is for the purpose of preventing the falling metal from running into the tuyere.

LETTERS FROM PRACTICAL MEN.

Milling Machine Feeds.

Editor American Machinist:

Referring to my article of November 30th regarding trouble from "backlash" on milling machine when running the work with the cutter, I would say Mr. J. E. Sweet's version in issue of December 21st, in which he states that "spring in mandrel, machine and work will be found a more troublesome element to deal with than lost motion," coincides with mine.

Mr. McGregor, in the same issue, writes that he "has watched the operation of some large milling machines on motor gears with no arrangement for taking care of 'backlash,' and the foreman declared that he spoiled more cutters than the whole thing was worth." I regret that he did not continue and say that this same foreman had no difficulty in milling the pieces (as per his article November 9th) on the same machines with a decidedly coarser feed. If Mr. McGregor had arranged so as to bring the surface of the platen in closer proximity to the center of cutter arbor, instead of 14 inches below, or had used a machine of same power with screw feed and a platen set low on a bed that was supported on box legs, with provision for vertical and horizontal movement made in the head, his foreman's troubles would have undergone a vast modification.

In the range of my observation there has been focused designs that appear to aid in the elimination of the "backlash." A prominent machine tool builder produces milling machines with a feed screw and compensating nut, both cut with U. S. Standard thread. This nut is made in halves, firmly bolted and doweled to the platen. When the screw becomes so badly worn that the nut cannot be adjusted to it, it is taken out, mounted in a lathe and "trued up"; the nut is also removed, closed a little, mounted on a face-plate and recut to fit the corrected screw. The tools for obtaining above results can be manufactured in any shop at

very small cost, the screw and nut being replaced practically new as far as lost motion is concerned. The advantages of above over those of a square thread and solid nut are apparent. For rack feeds the pinion, or rack, could be made in two parts, or double, and the teeth "staggered" in order to get the requisite adjustment. Some of the machines produced by aforesaid people are arranged for driving the feed screw with worm, worm-wheel and feed-shaft, connected to and moving with the saddle and knee, connection between main spindle and feed-shaft being made with feed cones, belt and train of gears, mounted on a swinging arm which allows for vertical movement of saddle and adjustment of feed-belt tension. This produces a uniform feed movement, which, I think, is essential on milling machines in order to produce good work with maximum feed. The above, or something similar, is, I think, preferable to a feed-shaft arranged with universal or Hooke's joints, it being a well-known axiom that this joint transmits a uniform motion only when the axis of the two shafts are in line, the variation in velocity ratio of the two shafts increasing as angle of shaft is increased. The effect of this variation could, I think, be neutralized to a certain extent if two joints were used, so located that the accelerated movement of one would tend to correct the retarded movement of the other.

I am not an advocate of the use of milling cutters with fine teeth, but have found by experience that there are places where they will give much better results than cutters with coarse teeth.

About six years ago I was detailed to remedy the difficulty which had arisen with a 24-inch automatic gear-cutting engine which our people had furnished a builder of cotton machinery. Among other things I took with me a few formed gear cutters 12 diametral, P. Epicycloidal form of tooth each 2 inches diameter, with, I think, 15 teeth. After adjusting a few minor details and getting the machine started satisfactorily, feeding 6 inches per minute, the superintendent of the works inquired if this was the best I could "offer," my reply being that the condition of the teeth on the back edge of gears where cutter came through the work was such that it was all the feed the iron would stand. The gears were 40 teeth, 12 diametral P., and the hub projected beyond the edge of rim $\frac{17}{32}$ inch on one side. In the same shop they had an old style hand-feed machine. Mounted on the work arbor of this machine was a string of gear blanks 12 inches long, the cutter used being about $\frac{1}{2}$ inch larger in diameter, and having about twice as many teeth as the one I was using. The operator on this machine was making about 70 cuts an hour; that is, a cut 12 inches long was made, the cutter returned to starting point, machine indexed, ready for the next cut in less than one minute. The gears cut were in better condition, and cutter was comparatively cool, although the feed was more than double that which I had used. After I had learned that the gears were being cut by the job, and that this feed was not "got up" for my benefit, the superintendent picked up one of the cutters and said: "Mr. L., I have been all through this thing, and have found that we can afford to throw away one of those cutters every time it becomes dull, and still get our gears out cheaper than possible with the use of formed cutters with coarse teeth."

In your issue of 7th ult. "Quirk," writing of cutters run in the old way, says: "Here the spindle is forced backward, we may say in a line parallel with the cut, or if anything slightly downward, for we know a sharp cutter will clear the work in running back."

If an axial cutter is used as per sketch accompanying his article I would say that this is a result I have never been able to produce. No matter how light the chip, the cutter would invariably leave a mark when run back, unless the work was lowered away, or the machine stopped before doing so. J. M. LYNCH.

Tool Grinding Per String.

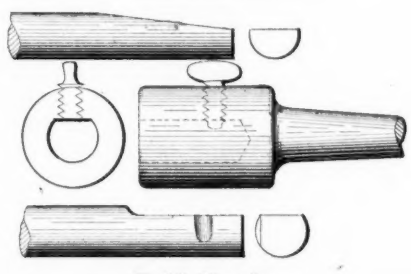
Editor American Machinist:

I find the following in the *Industrial World* of Chicago:

We have heard of a schoolboy having a string tied about his finger to keep him in constant remembrance of his dinner pail, but we never heard of a machinist taking a half dozen tools to a grindstone and tying strings about them as fast as they were ground, till we saw it stated in the AMERICAN MACHINIST. A machinist that cannot tell a sharp tool from a dull one had better tie up to some other trade. Even a saw-filer, when filing a circular saw, can't help noticing that the last tooth is coming in sight and that his job is drawing to a close.

When Bill Nye told his story about some soldiers getting under a building in which was stored a cask of whiskey, and on account of false measurements, or excitement, or some other thing boring an auger hole into the sleeping sentry instead of the cask, it is related by Bill that some of his German friends to whom he was talking got very mad and pronounced the story "all a tam lie." But it remained for the editor of the *Industrial World* (of Chicago) to seriously criticise my letter regarding the filing of band saws, and your comments on the same which appeared in the AMERICAN MACHINIST November 30th.

As the *Industrial World* in which this criticism appears is dated December 21st, it cannot be laid to Christmas, and we must therefore conclude that the late World's Fair is responsible. GREASER.



Drill Chucks.

Editor American Machinist:

Herewith find a rough sketch of my drill sockets and drill that give excellent satisfaction. I do not know whether they are new or not; I never heard of them elsewhere, and I shall not apply for a patent. They are for straight shank drills. One drill has a flat side parallel with it, and a thumb screw to prevent it from falling out, or a tapering pin through one side of the drill. The other has a flat side tapering about $\frac{1}{4}$" to the inch, with a hole for drift to force it out; the taper will hold it in. Of course, the socket has to be punched hot and turned true with the hole.

Tampa, Fla. J. H. WELLS.

Air Space for Boiler Furnaces.

Editor American Machinist:

There has been considerable talk and private discussion regarding the statement made by Mr. F. A. Scheffler in his paper before the American Society of Mechanical Engineers that he had successfully run a Stirling boiler with a grate having only 15 per cent. of air space, and in view of the amount usually considered necessary, it is not strange that this was questioned. But we are very apt to either forget to note down what has been done in the past or to overlook it, and it often leads us into error by answering before we have really looked the case over. It may be interesting in this respect to look back at a little railroad practice which has gone on record and see what has been done, not forgetting, however, to make allowances for the forced draft in this case. On the Delaware, Lackawanna & Western Railroad, in about 1856 or 1857, they were running wood-burning locomotives having a fire-box about 60 by 66 inches, and this was all blank at the bottom except a grate of about 18 by 24 inches near the center of the fire box, having probably about 50 per cent. air space through it.

This gives between 5 per cent. and 6 per cent. of air space for the whole fire-box, which is rather a low percentage, although wood as a fuel and forced draft account for much of this.

On the New York, Providence & Boston Railroad there were, between 1860 and 1870, grates in use which would be laughed at now, and probably not given a trial, because "any one knows they would never do," but they did. These consisted of plain flat cast plates, having round holes through them, about one inch in diameter and probably two inches between centers, making about 20 per cent. of air space.

These were used on account of durability, freedom from warping, etc., and were used very successfully for a number of years, there being no trouble whatever from lack of draft or steam from the boiler. Why they were abandoned it is hard to say, but presumably, as with many other things, they gave place to others which were just as good or no worse, and new things are often considered better by the majority.

We cannot always tell why old things are abandoned and replaced by others, and we are safe in saying that it is not always merit that does it.

As an example of this I may mention a certain railroad whose chief official convinced the directors that the engines they had were not economical nor fit for the work, and had some others built on the monstrosity plan.

These engines were put to work on the same runs, and it so happened that one of the old ones was pressed into service on a similar run. This continued without comment for nearly two years, when some of the observing engineers began to see and comment on the fact that the old engine was doing more work per pound of coal, and had not been in the shop for repairs in all this time, while the new engines, the "economizers," had been laid up half a dozen times and were burning more coal.

This got to the ears of the chief officer, who ordered the new engines, and the old engine was hauled off that run in a hurry, as he evidently was of similar mind with Mrs. Malaprop in "The Rivals," that "comparisons are odorous."

I do not mean to say that this was the case with the grates mentioned, but there are too many cases where the old machine is declared a failure so the new one can have an excuse for existing. FRED H. COLVIN.

The Test Too Delicate for the Indicator.

Editor American Machinist:

Referring to Mr. Willis' experiment with indicators recently given in these columns, I will say that it was the finest test that instrument has been subjected to, that I have had the pleasure of reading. As it were, Mr. Willis hoodwinked those indicators, and then asked these questions, but instead of answering in favor of a short, straight pipe, as is generally supposed they would, they made these replies just as though nothing had happened, and the only logical conclusion is that the indicator is not sensitive enough to be influenced by a long or short pipe.

The test was novel and complete, and will tend to make the indicator what it should be—*i. e.*, "an instrument of precision."

C. O. SINE.

Milling Machines and Feeds.

Editor American Machinist:

For the past two years I have been in almost all the shops in the country that are using heavy milling machines, and have read and watched your paper for the articles on milling, particularly the articles by Horace L. Arnold, who gives us information as to what the Pratt & Whitney Co. are doing on their milling machines. Not being interested in the manufacture of milling machines, but very much so with the output, I would say that whoever is responsible for the experiments made on milling machines at railroad feeds and in "the new way," I think if he had to pay the bills (to say nothing of the "cussing" he has caused) he would have to be very rich indeed if he could square himself. I should like to have the address of a few of the shops who have the machines arranged so that the feed can be reversed, and where they are doing the work any cheaper than by the old method. There might possibly be a few, but I doubt it, for in every instance where I have seen these machines working and doing good work, they are by no means using the railroad feed. That is, where they want good work, they have tried the speed used in the test that was made for them, and getting "hen scratched work," breaking lots of cutters and with them several commandments, they have returned to the old way. Then, again, I have been in shops where, with a new machine or a new attachment put on the old machine for holding the carriage from "climbing the cutters," it has worked very fine for a time, but when one job of milling was done for some time, or several of nearly the same length, the screw or the rack would become worn so that if the adjustment was taken for the center of the carriage movement, it could not be moved at the ends, with the result that the "old man" would walk around some morning when his breakfast did not fit him and tell the foreman that he had "spent about enough on that theory; suppose you come down to common sense and make a little money out of that milling machine." The milling machine would then be run the other way, and it would pay.

The next shop I would visit I would express my ideas, and they would look at me with kindly pity, and tell me to come out in the shop; there I would see a job that was being milled fast—very fast, indeed. "What do you think of that?" I did not like to speak too quick, but I did not think that from the reputation of the firm the work was good enough. I acknowledged that it was fast work, but asked permission to walk around the shop, and, just as I expected, there was the fast job being finished on a planer. I obtained the time on both, and the result was anything but fast. I sounded the foreman, and he told me that he knew that he could run the cutters the "right way," as he expressed it, and feed slower and do the work quicker than it was now being done on the two machines, and at the same time save the high wages of the machinist that run the planer; but he said he had his orders, and had his "fingers burnt" once by mentioning this to the "old man." I might have minded my own business, but I could not help telling Mr. Blank what I saw; the results were, to put it mildly, astonishing, for Mr. Blank was not the "old man" that the foreman referred to, but one of the other members of the firm, who, I found out afterwards, had been convinced against his will, and, while a practical man, was the office man of the firm, and as long as the milling machine was doing what the rest said it would, he was satisfied. I do not know for a fact, but I will wager a big apple that the milling machine is now running the other way and milling as if it were cutting steel, and not as though it were cutting wood, and at the same time it is leaving the work true when it leaves the machine, not so that it has to be trued up on a planer, and is doing it at considerably less cost. As I stated above, I am interested in the results of milling, and as the experiments caused me to do considerable thinking as to whether I was getting left on my milling or not, and from the five and ten-minute tests on new machines I could not help but think I was. I have to thank the firms who were kind enough to make and *pay* for a few *weeks'* tests, as I now have at their expense results which have saved me recommending the firm to go to the expense and trouble of finding out that the old way of running a milling cutter at the proper feed was the only way of obtaining good work for ten hours a day, and 300 days in a year; and also that the new way was the proper way to make tests for ten or twenty minutes, and then have the results published and have your name always remembered by the man that follows your advice and "pays the bills." MILLING CRANK.

The London *Times*, in its annual review of trade, places the year 1893 as the worst since 1880. American competition in the carpet, shoe and screw trades is cited as amongst the causes.

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Smoke Prevention.

The president of the steam heating company in this city is reported to have said during the recent attempt of that company to burn soft coal in spite of the city authorities that the saving by the use of that fuel under a part of their boilers only was $200 a day. This may or may not have been an exaggerated statement; it probably was. But in any event there was undoubtedly an important saving which the company was obliged to forego because of the smoke nuisance.

It is astonishing that in the apparently simple matter of smoke prevention the ingenuity of man has not been able to modify natural laws to any very important extent. The quantity of unconsumed carbon, which is the principal trouble making constituent of smoke, is small comparatively, but its satisfactory combustion in the furnace, or before it reaches the chimney top, has baffled the skill of the engineer and the scientist for a good many years. At one time an immense amount of fuel was believed to go to waste in the form of unconsumed carbon in smoke. The fallacy of this supposition has been shown by an analysis of dense smoke from a furnace in which bituminous coal was being burned, the result being that the escaping carbon was a wonderfully small percentage of the total in the fuel used.

The fallacy was one for which no one appeared to be directly responsible, and like many another error still keeps on traveling. It got into the form of a "popular science" item in the daily press, from which such items get strained through weekly and monthly editions and then begin their rounds again. They may be differently dressed every two or three years, but they never die.

The trouble with the unconsumed carbon in smoke is that it is in the wrong place. It pollutes the atmosphere and blackens and defaces everything about it, insinuating itself into closely shut drawers and penetrating the closest of closets. If it at once, after getting beyond the possibility of combustion, found itself in some place where it could go to waste in a state of innocuousness the loss would not be great enough to call for serious attention. This may be the disrection in which the thought will tend that solves the problem of the satisfactory use of bituminous coal in great manufacturing cities. Some—not very much—attention has been given to this disposition of the carbon nuisance at different times, but the popular idea still seems to be that somehow a great saving in fuel must accompany the prevention of smoke. That is neither possible, nor necessary to success. Absolute smoke prevention without loss in fuel consumption is all that can be expected, and is in itself quite enough. Even a trifling waste in fuel may be overlooked if the chief end is accomplished. In a city like New York, for example, the difference in the cost of a given amount of heat potentiality as between anthracite and bituminous coal would make a very important saving possible even if something were sacrificed for the purpose of preventing smoke in the burning of the latter, and it would immensely alter the conditions of many Western cities where the burning of fuel yielding dense smoke is practically a matter of necessity.

There is, to-day, just as much room as there ever was for devices that will overcome the smoke nuisance. The man who satisfactorily solves the problem presented will be a public benefactor, and he ought to make money from his efforts.

The Shop Kicker.

In shops the man who is "always kicking about something" soon loses what popularity he may have had, and is apt also to lose his job, and yet even kickers have their uses. It is a mere truism to say that most improvements are made as a result not merely of some one seeing that there is room for improvement, but insisting that such improvement should be made, and this is usually called kicking.

The formation of this Government and all the good that has resulted from it commenced in a vigorous and determined kick by men who thought they were being imposed upon, and who were regarded as cranks and senseless fault-finders by those who in that day thought, as many think now, that we should let well enough alone, and be satisfied with things as they are.

From the most important public questions to small matters of shop management, there are kickers and kickers, some who kick with insufficient reason, and others whose kicking is really almost the principal cause of discussion, progress and improvement.

A machine shop goes along for years without an effort to keep things decently clean. The tools become buried in accumulated strata of oil and dirt until it becomes an utter impossibility for a workman to use them and retain the sense of touch needed to properly handle tools and get good work out of them, even if the limited amount of light struggling through the dirty windows, and not absorbed by the dirty, black walls and ceiling would permit him to do any really good or close work. Finally the kicker comes along, and kicks—actually asserts that there should be such things as benzine and cotton waste, and soap and water and brooms in a machine shop, and that a man leaving a lathe or a drill press after doing a job upon it, should leave it in decent condition for the next man; that there should be a general wiping up of machines once a week. He keeps up the kicking about this until possibly he stimulates one or two others to feebly join him, and finally there is an improvement which very much increases the efficiency of that shop and the profits of its proprietors, as well as the comfort and self-respect of the men who work in it; but by that time the kicker has usually become recognized as a "chronic," and is "sacked," his beneficent influence, however, remaining as a permanent fixture.

Another shop has an inadequate heating system, causing a goodly portion of the time that should be spent in doing work to be devoted instead to the blowing of fingers, swinging of arms, and standing about stoves, to say nothing of loss of time through severe colds, pneumonia, and even consumption brought on by exposure. A kicker appears here also and brings about an improvement, enabling the men to work in comfort, and the proprietor to make more money, but the chances are that unless he is a very skillful kicker, he loses his job.

And this brings us to the point that there are different ways of kicking. A man may kick skillfully and to some purpose without injuring himself; or on the other hand he can kick in such a manner, or at such a time, or under such circumstances, as to produce no other result than his own discomfiture. And again there are shops in which no kick can possibly do any good, and in which the only perceptible result of a kick is to react upon the kicker.

Kicking is right and proper and necessary under certain circumstances, but the man that feels inclined to kick had better be careful, in his choice of time, place and method, for he may kick himself into a better position, or out of a job, depending upon his choice of time, place and method.

And for proprietors of machine shops there is a right and a wrong way to deal with kickers. Sometimes a vigorous kicker is in reality a valuable acquisition for a shop, and before deciding what to do with one it is wise to first carefully consider whether there is just cause for kicking, and if so whether or not the removal of that cause will not make the non-kickers also better satisfied, and tend toward increased profits in the business.

We find upon the "woman's page" of a daily paper an item which, presumably, is put there to please its women readers, and is to the effect that an overseer of a spinning room declares that girls are better spinners than boys, among the reasons given being that girls are "more tractable, less inclined to strike for higher pay," etc.

We wonder who can be so short-sighted as to be gratified by such a statement. Is it not true that men and women stand or fall together in the matter of wages when pursuing such occupations as spinning? When men demand higher wages, or resist a lowering of them, are not women at least as much interested in the result as the men themselves can be?

There can be no doubt whatever that the entrance of women into occupations formerly monopolized by men has resulted in the injury of both men and women, and by the cheapening of labor tended directly to lessen the effect of what has been one of the principle incentives to the use of labor-saving machinery, *i. e*, high wages.

Low wages are not economically advantageous either to manufacturers or to any one else. Though it is, of course, to the advantage of any individual manufacturer to get the grade of labor required by him at as low cost as possible, it is at the same time to the interest of that same manufacturer that the general rate of wages should be high because the purchasing power of the masses determines demand for manufactured goods. Just in proportion as women enter factories, become industrial employes, and by being "tractable" reduce wages, will they make it the more necessary for men to contend for living wages and we are thoroughly convinced that there is absolutely no class of people living in this country which is not interested in having high wages—wages which enable one man to support in reasonable comfort, not only himself, but also a wife and children.

Nathaniel Wheeler.

The president of the Wheeler & Wilson Mfg. Co., Nathaniel Wheeler, died at his home in Bridgeport, Conn., Sunday, December 31st, at the age of 73 years. Starting in life as a manufacturer of buttons and small metallic articles, he was attracted by the sewing machine of Mr. Wilson, which was on exhibition in New York, and, with others, organized the company which, in 1853, became the Wheeler & Wilson Mfg. Co., and in 1856 moved its factories from Watertown to Bridgeport, where extensive works were erected. Besides being a successful manufacturer, Mr. Wheeler was one of Bridgeport's most public-spirited citizens, and served the city faithfully and well in several official positions. He was also a member of the State Senate twice, and four times of the House of Representatives.

Literary Notes.

OBJECTS OF INTEREST TO ENGINEERS AND OTHERS, IN AND ABOUT PHILADELPHIA. Presented with the Compliments of the Engineers' Club, of Philadelphia.

This little book is an excellent handy guide for the use of engineers and others visiting Philadelphia. It contains a list of some of the more prominent objects, arranged in approximate geographical order with references to accompanying maps. In this list, the objects which, from their magnitude or importance, seem especially worthy of notice are indicated by single, double and triple stars, so as to enable a visitor, having but a day or two to spend in the city, to more readily plan his movements. A more complete list of the principal objects of interest, arranged in alphabetical order and interspersed with useful and interesting notes, is also given. This guide will undoubtedly be appreciated by all who may possess a copy. It can be procured at the Engineers' Club, of Philadelphia, 1122 Girard street, Philadelphia.

A TEXT-BOOK OF MECHANICAL DRAWING. PART III. MACHINE DRAWING. By Gardner C. Anthony, A. M., Professor of Drawing in Tufts College; Dean of the Bromfield-Pearson School; Member of American Society of Mechanical Engineers.

This excellent little book is the third one of a series treating on mechanical drawing. This part is intended to teach the practical application of the principles of projection to the illustration of machinery, and to point out the conventional methods which may

sometimes be used with advantage in place of the rigid adherence to the laws of projection in securing an accurate and complete expression of mechanical ideas. It is written for students who have made some advance in the study of mechanical drawing, and therefore this treatise presupposes a knowledge of the use of instruments and the theory of orthographic projection. The book is very practical and progressive in character, making it very suitable for use in the classrooms of high schools, evening drawing, and technical schools.

The book contains 50 pages of letter press, interspersed by 40 cuts and followed by 16 full page plates. Its price is $1 80, and copies can be obtained by addressing Gardner C. Anthony, Tufts College, Mass.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(16) A. B., St. Louis, Mo., writes: Please give a rule for computing correctly the force in tons with which a steam hammer will strike. The cylinder is 12 inches diameter, 37 inches stroke, the hammer weighs about 1,500 pounds, the steam pressure is 100 pounds per square inch. *A.*—You will find these rules given very completely in answer to Question 473, in our issue of September 21, 1893.

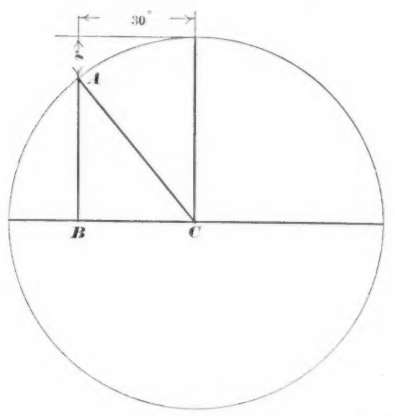
(17) A. T. H. P., Cleveland, O., writes: Kindly state if there ever was a steam engine built without a crank or slides. If so, state the construction of cylinder and other principles? *A.*—Rotary engines have no cranks or slides; the construction of cylinders for the different types of these engines varies so much that we have no space for their description. There has been a number of crank engines built without slides, the parallel motion taking the place of the slides; in these the cylinders are of the same construction as in any ordinary engine.

(18) R. T., Dorchester, Mass., writes: Please answer the following questions: What are the names of gases of which air is composed? And in what proportion? Also give similar information relating to water? *A.*—Air is composed by volume of 21 parts of oxygen and 79 of nitrogen; by weight, 23 of oxygen and 77 of nitrogen. These gases are not chemically united, but are mixed mechanically. Air also contains $\frac{1}{2000}$ of carbon dioxide, some aqueous vapor, and small varying amounts of ammonia, nitric acid, ozone, and organic matter. Pure water consists of hydrogen and oxygen in the proportion of two volumes of the former to one volume of the latter; or by weight it is composed of two parts hydrogen united with sixteen parts of oxygen.

(19) L. E. B., Detroit, writes: 1. Wishing to turn any certain taper, is there any rule which will show how far to set the tail center over to get the required taper? *A.*—There is no rule which in practice will give accurate results, but if you multiply half the difference in diameter between the small and large end of the taper portion by the total length of the work, you will have the distance to set over approximately provided the tool be set level with the center. It would be exact were it not that the centers enter the work an indeterminate distance. 2. I have a lightning center reamer (60°) in good cutting order, but I can't get it to ream a smooth center. I have a good, solid foot lathe. I have revolved the reamer with work, stationary and *vice versa*, and I have tried all speeds. Could you suggest any reason why I don't have better success? *A.*—Take an oil-stone and reduce the clearance on the reamer.

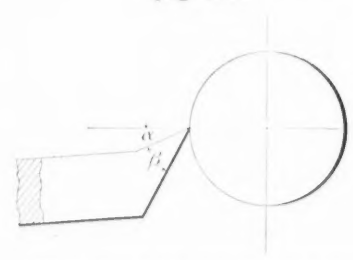
(20) W. T., Coxsackie, N. Y., writes: I send with this a sketch of a small water tube boiler. I would like to know if this boiler is large enough for an engine with cylinder 2⅜ inches diameter, 3 inches stroke, which I rate at one horse-power. The boiler consists of a drum 4½ inches diameter, and 26 inches long; eight pieces of ¼ inch pipe, 16 inches long, and eight pieces of ⅜ inch pipe, 12 inches long. These pipes are bent around the drum and the whole is set inside of a shell lined with asbestos. The grate surface is 13½ inches in diameter. If this boiler will run the engine, I intend to put it and the engine in a boat. What size boat will it drive, and what size of propeller will I need? If this boiler is too small, what size engine will it run? *A.*—The boiler is too small for the given size of engine, and its construction is so bad that we would not advise its use for any purpose. The engine with 40 pounds mean effective pressure and running at the rate of 400 revolutions will develop about 1¼ horse-power. For this engine we should use a plain upright boiler, diameter of furnace 21 inches, height of furnace 21 inches, outside diameter of shell 26½ inches, height of shell 36 inches, flue 7½ inches diameter. This boiler and engine will run a boat 22 feet long, 4½ feet wide, and 2 feet deep. Diameter of propeller 14 inches, pitch 24 inches.

(21) R. E. C., Marlboro, Conn., writes: Please answer the following question: How much drop r will there be in a circle at 30 miles and at 130 miles as indicated in the sketch? The circumference of the circle is 25,000 miles. *A.*—To compute this is not a difficult matter. First find the radius $A\ C$ by dividing the circumference by 3 1416; one-half of the quotient will be the radius $A\ C$. The distance $B\ C$ from the center of the circle is given, hence we have a right-angled



triangle $A\ B\ C$, whose hypotenuse and base is known, and all we have to do is to find the length of the side $A\ B$ and subtract this from the radius; the result will be the drop r. The side $A\ B$ of the triangle $A\ B\ C$ is found as follows: From the square of the hypotenuse $A\ C$ subtract the square of the base $B\ C$, and then extract the square root of the remainder; the result will be the length of the side $A\ B$. In this way we find the drop r, when $B\ C$ is 30 feet, equal to .12 of a mile, and when it is 130 feet, 2 13 miles. For greater accuracy, carry the root to a greater number of decimals.

(22) C. G. S., Magdeburg Buchau, Germany, writes: I should feel much indebted to you if you could give me some reliable information about the best cutting angles for tools. The best known German pocket-book for engineers, "Hütte," gives the following data, and for fairly hard stuff I think β is very small, and should like to know the American opinion on the subject. Extract from the "Hütte," 1892, Vol. I., page 537.



CUTTING ANGLE FOR USING LEAST POWER.

	α	β
Wrought iron	8°	51°
Cast-iron	4°	51°
Bronze	4°	66°

A.—We note the statement above that these are the angles for "using least power," which may be, and in most cases is, we think, a very different matter from the best angle, all things considered. We are not able to give the best nor even the generally used angles for tools, because these vary so much to suit different circumstances, such as degree of hardness of the metal being cut, quality of steel of which the tool is made, depth of cut, kind of finish desired, etc. The angles that cut with the least expenditure of power are easily determined by a few experiments, but the best angles must be determined by good judgment, guided by experience. In nearly all cases, however, we think the best practical angles are greater than those given for β.

(23) C. K., Muncie, Ind., writes: Please give me the names of books, and where published, for home study preparatory to taking a course in mechanical drawing. I wish to have elementary works on algebra, geometry and trigonometry, and perhaps mechanics. *A.*—"Elementary Geometry," school edition, by E. Olney; "Complete Algebra," by the same author. Both are published by Sheldon & Company, New York and Chicago; the geometry also includes trigonometry. "Theoretical Mechanics," by J. E. Taylor, published by Longmans, Green & Co., New York, and "Principles of Elementary Mechanics," by Prof. De Volson Wood, published by John Wiley & Sons, New York. See "What to Study and How to Study" in our issue of February 19, 1891. 2. Also give me the name of some good mechanical drawing school which a man of moderate means can attend. *A.*—The Correspondence School of Mechanics, Scranton, Pa., is earning a good reputation. The articles on practical drawing published in our columns were written for home study. It should be understood that the books mentioned above are not the only ones treating on the subjects named; there are many others just as good; we mention these because we are familiar with them.

(24) S., Mt. Carmel, Ill., writes: I would like to know how to take care of a steam boiler. Is there any preparation that will keep the boiler from rusting inside? I have a boiler which is not used continually, and consequently it has a chance to rust. I use clean rain water. *A.*—When the boiler is to be taken out of service, do not blow out the water by the pressure of the steam; the water must be allowed to remain in the boiler until it is cool, and then permitted to run out through the hand hole and blow off cock; after this, clean the boiler thoroughly. There are several ways of preventing the boiler from rusting. One way is to refill the boiler gradually, after it has been cleaned, with warm water, care being taken that the boiler is also warm before refilling, so as to avoid the danger of unequal expansion; if cold water is used a light fire should be kindled in the furnace after the refilling, so as to heat the water; when nearly full one or two gallons of crude oil should be put in the boiler, after which the water is permitted to run out slowly through the bottom blow-off cock. The oil which floats on top of the water will adhere to the inner surface of the boiler as the water level is lowered. When the boiler is empty close it up tight. Another way is to clean and dry the boiler thoroughly; and to protect it from moisture, a light fire of shavings should be kindled in the ash pit about once a week. Some engineers fill the boiler quite full of water and close up tight.

(25) S. R. H., Watertown, Conn., writes: A friend of mine has a boat 18 feet long, 4 feet 6 inches beam, and drawing 14 inches of water. The boat is fitted with a compound engine, with cylinders 2¼ and 3⅜ inches in diameter, and 2½ inches stroke, designed to run at 550 to 600 revolutions per minute. What should be the size of the propeller? The one that came with the boat has 4 blades, 14 inches diameter, but the engine makes about 350 revolutions per minute only, and we believe we are not getting all out of the engine that we should get. *A.*—You do not give the pitch, but this is probably 24 inches; if so, it can hardly be said that the propeller is too large, although on boats of the size given, propellers 12 inches in diameter and 21 inches pitch will often give good results. If the boat is to run in smooth water, and speed is the principal object in view, we should use a propeller with two blades, 14 inches diameter, and 24 inches pitch. But if the boat is to run in rough water, and speed is not so much of an object as efficiency, we should use three blades for so small a propeller. For smooth water the two bladed propeller is the most efficient, but its efficiency is rapidly impaired as soon as the boat begins to pitch. The unsatisfactory results of your engine may not be due to the propeller, we are inclined to believe that the boiler does not generate steam rapidly enough, and may be too small for the desired amount of work, or there may be defects in the construction of the engine. With the proper size of boiler, and the engine in good working order, at least 450 revolutions per minute should be obtained.

(26) B. F. M., Mifflinburg, Pa., writes: Will there be any appreciable loss in fuel and water by mounting two 8 horse power engines on a boiler, in place of one 16 horse-power engine? The engines are to be coupled to one shaft by gearing. *A.*—There will be a little loss. 2. Suppose that a tubular boiler 8 feet long and 35 inches diameter had placed on its center a drum 24 inches diameter, and about 30 inches high, and the shell inside the drum cut out to the full diameter of the drum, would not the remaining part of the shell be as strong as the longitudinal seams? *A.*—The remaining part of the shell will be composed of a solid plate, and this, as far as tensile strength is concerned, will be stronger than the longitudinal seams, but it is very doubtful if it will be as strong as the transverse seams. But in any case there is too much cut out of the shell, which will weaken the whole construction of the boiler, and allow its form to be distorted to a very dangerous degree; it is exceeding bad practice to put on a dome in this way. We should use a dome of smaller diameter, and flange the shell upwards to fit the inside of dome, so that the two may be riveted together; the dome should also be flanged outwards to fit the top of shell, and these two, with a wrought-iron re-enforcement ring about ⅝ inch thick and about 3½ inches wide placed inside of shell, should be well riveted together. 3. Would it not be good practice to have the longitudinal seams welded instead of riveted? *A.*—Yes, there are many boilers made in this way now. 4. Why are not boiler tubes made 30 or 40 inches diameter as well as the smaller sizes? *A.*—They can be made that size, but we suppose the demand is not great enough to keep these in stock.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

Chucks, the Nat'l, est'd 1882 39 Cortlandt St., N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N. J.

The American Packing Ring requires no change in your pistons. J. H. Dunbar, Youngstown, O.

Upright Drills, stationary head, W. & L., with or without B. G. J. E. Snyder, Worcester, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Proceedings of the Mechanical Section of the American Association for the Advancement of Science Meeting at Madison, Wis.

IMPROVED FORM OF TRANSMISSION DYNAMOMETER.

BY S. W. ROBINSON, COLUMBUS, OHIO.

The dynamometer has two pulleys, A and B, Fig. 1 (page 10), one to receive and one to transmit power. The pulley A is attached to the gear C, and the pulley B to the gear E. D is an intermediate gear, which is attached by means of a lever arm $L\ J$, and an axle $J\ K$ to the weighing lever $F\ M$. Two pans, G and H, are hung from this lever, and on these equal, or different, weights are placed, as described later. A sliding weight is made so as to move along the lever $F\ M$, and proper graduations are marked on this lever.

The wheel A receives the power, and transmits it through the gear wheel C to the gear wheel E and pulley B. The gear wheel D is set so that the line of action between it and the wheel C is on the center of the axle $J\ K$. The only force tending to rotate the wheel D about the axis $J\ K$ is, therefore, that exerted between it and the wheel E, and this force is measured on the weighing arm $F\ M$.

The pans G and H are loaded with equal weights at starting, and in order to measure the power the weights are shifted from one pan to the other in addition to moving the sliding weight that is placed on the arm $F\ M$. The object of placing all the weights on the pans at starting is to introduce con-

siderable mass so that the fluctuations in the position of the weighing arm will be reduced to a minimum.

The pulleys may be swung around the axis *J K* so as to receive belts from any direction.

The friction affects this dynamometer less than in those of other types employing bevel wheels, for the friction of the axle *A*, and that produced by the contact of the gear wheels *C* and *D*, does not affect the readings.

Prof. L. M. Haupt asked what the per cent. of error was in this dynamometer, and what advantage it possessed over one he had described before the Association last year, which consisted of a pulley mounted on ball-bearings, the torsion of which was resisted by a spiral spring.

Prof. Robinson answered that he considered the dynamometer accurate to within one per cent., and that it was more free from fluctuations than a spring dynamometer of equal sensitiveness.

ON THE CHANGES IN THE DIMENSIONS OF METALS WHICH MAY BE DUE TO CHANGES IN MOLECULAR STRUCTURE DEPENDING ON THEIR AGE.

By Wm. A. Rogers, Waterville, Maine.

Measurements made on three bars during the last thirteen years show that they have not altered their relative lengths. The bars are of steel, brass and glass, one meter in length. When measurements are taken they are supported at points about one-quarter of their length from each end. The glass bar was made by Chance & Sons, in 1870, for the special purpose of this investigation. The largest variation from a mean value of all the comparisons made on the steel and bronze bars is about one forty-thousandth of an inch, and for the glass bar one twenty-five-thousandth of an inch.

Marks placed on the sides of the bars midway between the two end marks show that all the bars have sagged down slightly at the middle. This may have slightly altered their lengths but if it has done so the length of each has been altered the same amount. It was the opinion of the investigator that there were no changes due to molecular action, and if any changes had occurred they might have been caused by a slight sagging of the rods. He expressed regret that many standards were not provided with a middle line to determine the amount of bending which may take place.

Prof. Thomas Gray quoted tests made by the British Association in Sir Wm. Thomson's laboratory. Long wires were hung with various weights on them up to nearly the elastic limit. The change of length was hardly noticeable. The old and new standards at Washington have been found to differ in length, so that a long period of time may have some effect.

Prof. Rogers answered that it was true that the old and new standards at Washington differed, but he considered that this arose from the fact that the old standard was not as accurately calibrated as the new one.

Prof. Mansfield Merriman asked if the bars would not be of the same length for a small amount of sagging if they were supported at points one-quarter of their length from each end.

Prof. Rogers said that this would be true if the measuring points were on the center line of the bar, but as the marks were on the side of the bar the distance between them would not be the same.

The change in length of tempered steel bars was then discussed, and it was suggested that this action might be present in a smaller degree in other metals.

Prof. Rogers answered that, for the metals used in his bars, the change in thirteen years had not been appreciable, and that this action could not, therefore, have taken place.

EXPERIMENTAL DETERMINATION OF THE QUICKNESS OF ACTION OF A SHAFT GOVERNOR.

By D. S. Jacobus, Hoboken, N. J.

The experiments were made on the governor of a 50 horse-power Ball engine, and the results of the same are to be used in a paper to be presented by Mr. F. H. Ball and the writer to the American Society of Mechanical Engineers.

Figs. 2, 3 and 4 show the path traveled by the center of the valve eccentric when the load is suddenly changed. As the eccentric is moved directly by the governor the number of revolutions required to effect a change in the position of the governor is shown by the number of revolutions to effect a change in the position of the eccentric. The diagram for the eccentric travel, therefore, shows the quickness of action of the governor. The indicator cards taken before and after changing the loads are shown in Figs. 5 and 6. Fig. 2 shows the path with no dash pot when the springs were set so that the governer is just at the point of unstable equilibrium. Fig. 3 shows the path when the initial tension of the springs was made much less than for Fig. 2, so as to give great stability with considerable variation in the number of revolutions of the engine per minute between light and heavy loads. Fig. 4 shows the effect of a dash pot, the springs being set at the full theoretical tension, so that without the dash-pot the governor would be unstable.

The diagrams show that the dash-pot diminishes the action, so that twice the time is required to move from one position to the other with the dash pot on, as is required with no dash-pot. It is also shown that the quickness of action is very nearly independent of the stability of the governor, for, in Fig. 3, where the governor runs at 40 revolutions per minute less than the speed for perfect adjustment, the number of revolutions for the governor to move from one position to the other is the same as in Fig. 2 where the springs are set so that the governor is slightly unstable.

Further experiments are to be made to determine the action of an inertia weight. The results of the experiments with and without a dash-pot, however, show that for most classes of work the inertia weight will be an unnecessary refinement. By introducing the dash-pot we diminish the quickness of action so that twice the time is required to effect a given change in the governor as when no dash-pot is employed. Nevertheless this governor with the dash-pot attached gives as quick a regulation as is necessary for electric lighting and other work. If, therefore, the quickness of action can be diminished, so that twice the time is required for a given adjustment, without affecting the practical working of the governor, it will be an unnecessary refinement to increase the speed of action above that obtained with no dash-pot.

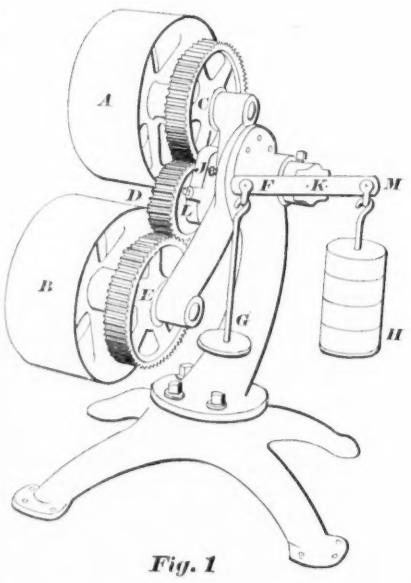


Fig. 1

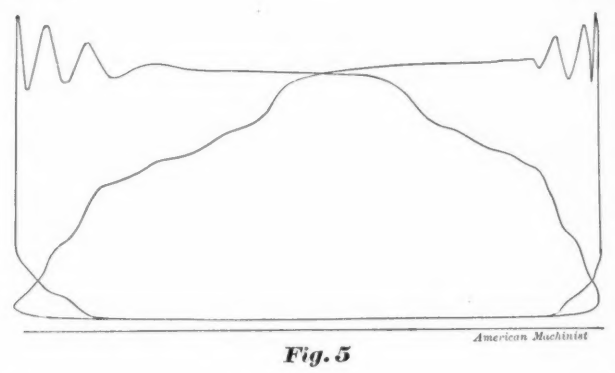


Fig. 5

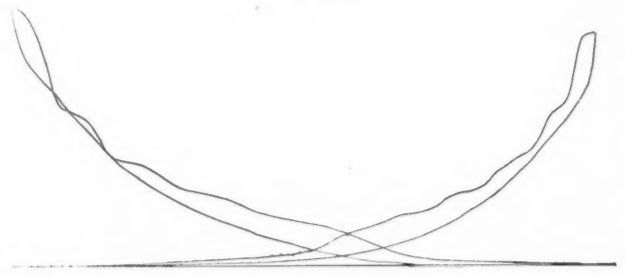


Fig. 6

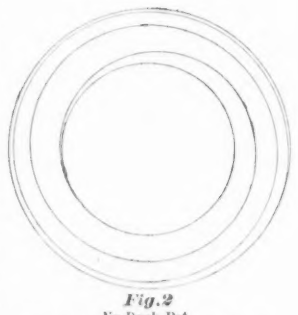


Fig. 2
No Dash Pot.
Tension in Springs Adjusted so that Governor is Slightly Unstable.
Revs. = 265 per Min.

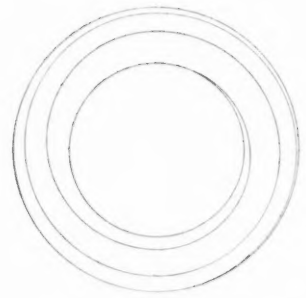


Fig. 3
Tension in Springs Adjusted so that the Governor is in Stable Equilibrium.
Revs. = 245 per Min.

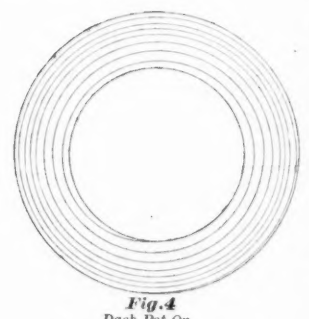


Fig. 4
Dash Pot On.
Governor Springs set at full Theoretical Tension.
Revs. = 285 per Min.

TEST OF THE NEW YORK HYGEIA ICE MAKING PLANT.

By Messrs. A. G. Hupfel, H. E. Griswold and Wm. P. Mackensie, New York City.

The investigation was made upon the plant of the Hygeia Ice Company, situated at the foot of East Fifty-second street, New York City.

The ammonia compressors and attachments were constructed by the De La Vergne Refrigerating Machine Company.

There were three compressor engines, each operating two double-acting ammonia compressors. Two of the machines are rated at 60 tons ice-making capacity each, and the third 90 tons, giving a total ice-making capacity of 210 tons per day.

Preparations for testing were commenced April 1st. A two-days' test of the boiler was made on April 4th and 5th. Tests were then made of the agitator engine which is used to circulate the brine in the freezing tanks. Weighings were made of a number of cakes of ice from the six tanks, in order to obtain the average weight per cake and the loss due to sprinkling hot water on the cans to remove the ice from them.

On May 1st preparations were completed for a continuous test of the entire plant for one week. Indicator rigging was attached, revolution counters placed on the engines and pumps, and an attachment made for obtaining the mean position of the valve which controls the supply of live steam to the condenser.

To obtain the drip water of condensation in the exhaust pipes, oil separators, and that from the engines and pumps, the waste pipe was connected to a hose and the water measured off in barrels.

The positions of all valves, a record of which might be of use in subsequent tests, were noted at regular intervals during the continuous test of one week.

The plant was run for twelve hours per day because the demand at the season of the year at which the test was made could be met without pushing the plant to its utmost capacity.

The reboiler, pumps, etc., were tested in the evening of May 9th. Independent tests were made upon the re boiler, sprinkler, jet blowers and "Schaefer's pump" upon subsequent days.

The general arrangement of a portion of the plant is shown in Fig. 7.

The water which finally leaves the condenser *A* is the accumulation of the exhausts from the various pumps and engines, together with an amount of live steam injected into them directly from the boilers. This last quantity is used to make up any deficit in the amount of water necessary to supply the ice cans. This water on leaving the condensers is violently reboiled at *B*, and afterwards cooled by running through a coil surface cooler *C*. It then passes through an oil separator *D*, after which it runs through three charcoal filters, and deodorizes *E* placed in series and containing 28 feet of charcoal. It now passes into the supply tank *G*, in which there is an electrical attachment for detecting salt. Nitrate of silver tests are also made for salt daily. From this tank it is fed to the ice cans *H*, which are carefully covered, so that the containing water cannot possibly receive any impurities. The ice was perfectly clear and the edges of the cake sharp. There was but a thin core of air bubbles through the center of the cake. No odor or taste could be observed at the center of the cake, which is a crucial test for the quality of artificial ice, and shows that the method employed in the production of ice in this plant was a most perfect one:

The final results of the tests were as follows:

Net ice made per pound of coal in pounds.	7.12
Pounds of net ice per hour per horse-power	37 8
Net ice manufactured per day (12 hours) in tons	97
Average pressure of ammonia gas at condenser in pounds per square inch above the atmosphere	135.2
Average back pressure of ammonia gas in pounds per square inch above the atmosphere	15 8
Average temperature of brine in freezing tanks in degrees Fahr	19 7
Total number of cans filled per week	4389
Ratio of cooling surface of coils in brine tank to can surface	7 to 10
Ratio of brine in tanks to water in cans	1 to 1.2
Ratio of circulating water at condensers to distilled water	26 to 1
Pounds of water evaporated at boilers per pound of coal	8.085
Total horse-power developed by compressor engines	414
Percentage of ice lost in removing from cans	2.2

APPROXIMATE DIVISION OF STEAM IN PER CENTS. OF TOTAL AMOUNT.

Compressor engines	60.1
Live steam admitted directly to condenser and steam for pumps, agitator and elevator engine	26 9
Live steam for reboiling distilled water	6 5
Steam for blowers furnishing draught at boilers	5.9
Sprinklers for removing ice from cans	0.6

AN IMPROVED OVEN FOR DETERMINING THE SENSITIVENESS OF AUTOMATIC FIRE SPRINKLERS.

By D. S. Jacobus, Hoboken, N. J.

The oven was adopted after many experiments on automatic fire sprinklers, made under the direction of President Morton, of

the Stevens Institute of Technology for the New York Board of Fire Underwriters, and for other parties.

In the first tests for the sensitiveness of sprinkler heads, they were placed in an oven which was heated up slowly, and the time required to open them and the temperature of the air, as registered by a mercury thermometer, was recorded. This did not give strictly comparative results, because the temperature of the air was in excess of that recorded by the thermometer, and variations in the rates of heating caused different times and temperatures. To overcome the difficulty of the temperature of the air being higher than the thermometer, the oven was heated quickly up to a certain temperature and then slowly until the sprinkler head opened. The error of the thermometer was thus reduced to about 2 or 4° Fahr.

Tests were made in this way for some time, as the sensitiveness of a sprinkler was not considered to be of as great importance as many other features that must be embodied in a successful head, and as the method gave results that would indicate if the sprinklers were about of the average sensitiveness it was exact enough for all practical purposes.

maintain an approximately equal flow of hot air through the oven. There are a series of deflector plates so arranged that the hot air entering the oven is distributed so as to cause the temperature to be nearly equal at all points near the center of the oven. The temperature is measured by the thermometer *J*, which is held by the rod *K* that passes through an adjusting arrangement, which allows the bulb to be set at the same height and near the solder joint of the sprinkler head.

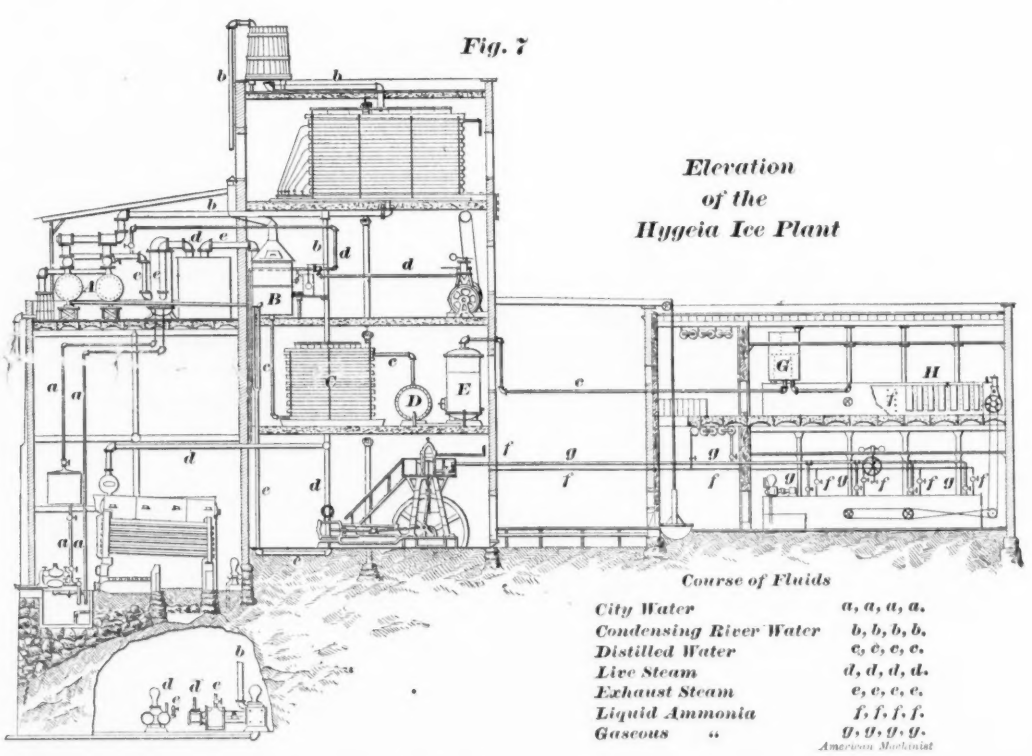
The sprinkler is introduced in the oven by opening the sliding doors *B* and *C*, and moving the pipe *L*, which is held in adjustable guides, until the sprinkler reaches the desired position at the center of the oven.

There is an outside cover to the box *A* that is not shown in the sketch, which prevents the hot air in the oven from escaping on opening the sliding doors *B* and *C* at the time the sprinkler is introduced. The water from the supply tank passes through the hose *D*.

The results given by this oven are quite uniform, provided the heads are set so that there is the same amount of stress on the solder joint of each. If some of the heads, however, are tightened up harder than

Fig. 7

Elevation of the Hygeia Ice Plant



Course of Fluids

City Water	*a, a, a, a.*
Condensing River Water	*b, b, b, b.*
Distilled Water	*c, c, c, c.*
Live Steam	*d, d, d, d.*
Exhaust Steam	*e, e, e, e.*
Liquid Ammonia	*f, f, f, f.*
Gaseous "	*g, g, g, g.*

American Machinist

cause the cooling action of the pipe tends to produce a downward current of air about the sprinkler head which slightly retards the action when the sprinkler is attached to the under side of the pipe.

ECONOMICAL STEAM COMPRESSION.

BY J. BURKITT WEBB, HOBOKEN, N. J.

In examining a number of articles on the subject of the best amount of compression in a steam engine cylinder, it was found that much that has been written on the subject is needlessly abstruse.

It should be noted that in none of the discussions, so far as appears, has any allowance been made for loss by cylinder condensation; Mr. Ball's paper, read before the American Society of Mechanical Engineers, alludes to it, however, but does not attempt to calculate it.

It is not proposed here to make a detailed review of what has been written, and this part of the subject will be passed over with a few remarks.

Professor Cotterill in "The Steam Engine" gives a discussion of the subject correct for theoretical cards as far as it goes, but treated in a manner calculated to justly

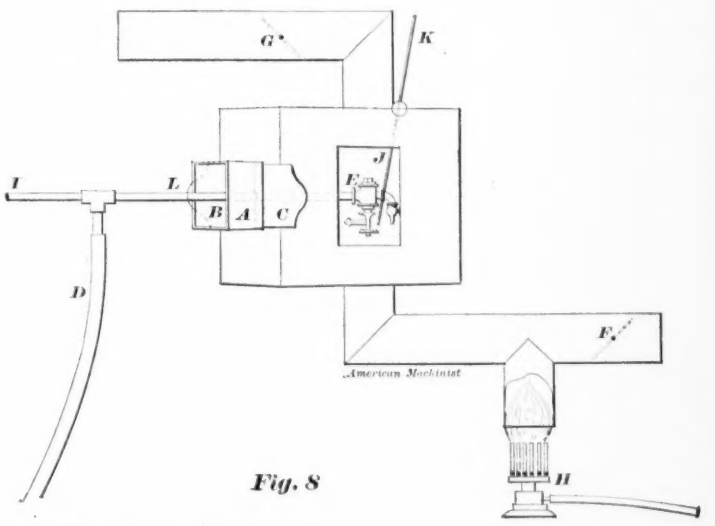


Fig. 8

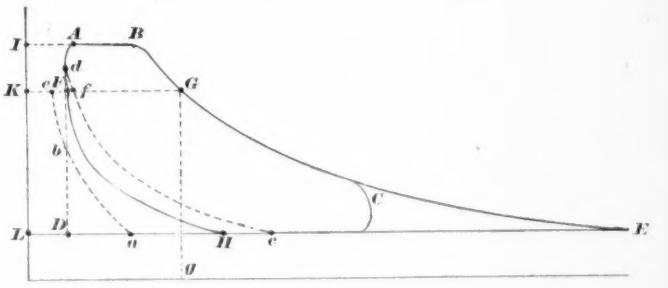


Fig. 9

It was afterward, however, considered desirable to devise an oven that could be employed to determine the relative sensitiveness with more exactness than in the one just described, and the final form adopted is shown in Fig. 8.

It consists of a sheet iron box two feet high, two feet long and one foot wide. The air in the oven is first brought to a given constant temperature, and the sprinkler is then introduced. The time required to set off the sprinkler head is noted by means of a stop-watch.

The sprinkler is placed in the small chamber *A* at the side of the oven. The chamber *A* is separated from the oven by means of two sliding doors *B* and *C*, and the air in it is at about the temperature of the room. Before placing the sprinkler in the chamber *A*, the water in the pipe leading to it is brought to the temperature of 70° Fahr., in order that the cooling action of the pipe shall be the same in each test. To accomplish this, the pipe is heated above 70° Fahr., and is gradually brought down to this temperature by allowing the heated water to escape through the pet cock at *E*, which is replaced by colder water from the supply tank. The temperature of the room is maintained at about 70° Fahr. The oven is heated to a temperature of 300° Fahr. by means of the Bunsen burner *H*. It is preserved at this figure by regulating the damper *F*. The damper *G* is employed to

others, and there is a great difference in the stress brought to bear on the solder joint, the times required to open will vary, being the least in those in which the stress on the solder joint is the greatest. The time required to open a sprinkler head of average sensitiveness is two minutes, the oven being at the constant temperature of 300 degrees, and the sprinkler and pipes leading to the same at 70 degrees before introducing the sprinkler in the oven. The most sensitive head we have tested required slightly less than one minute at 300° Fahr., and the most unsensitive of the standard forms four minutes.

In developing the form of oven just described, many experiments were made to test the reliability of the results obtained. Solder joint pieces were made of a uniform size, and were attached to a special sprinkler head where they were subjected to a given tension by means of a spring and weight device. This special head was placed in the oven, and the time to melt the solder joint noted for both upright and pendent positions.

In the first experiments the time required to melt the solder joint in the special head varied if the conditions were slightly altered. In the present form of oven the special head gave concordant results.

A sprinkler head placed in an upright position in the oven will operate more quickly than one in a pendent position, be-

intensify the prejudice against mathematical work which exists in the minds of so many engineers.

Professor Eddy's reference in his "Thermodynamics" to Cotterill's work, fully substantiates the above criticism, for certainly, being mathematically correct, it ought, if reasonably simple, to commend itself to one capable of writing a treatise on the subject of heat. The reference is as follows:

"Cotterill has, in his valuable treatise, investigated the problem in this (just explained) manner, but the results, which can differ from those just obtained by only an insignificant amount, are not characterized by simplicity of conception or expression."

Having been asked whether, to obtain the most economical compression, the real ratio of compression should be made equal to the real ratio of the expansion as stated by Eddy and others, it was considered to be easier and safer to work the problem out than to look up and compare all that has been written on the subject. After making the solution given below, the result was found to agree with that given by Cotterill.

Problem.—Let *A*, *B*, *C*, *D*, Fig. 9, be an indicator card without compression, and let it be required to cut off the corner at *D* by compression so as to effect the greatest saving of steam:

Solution.—Produce the expansion line *B C*, supposed to agree through a sufficient part of its length with a common hyperbola, to the point *E*, where it cuts the back-pressure line produced. Find the area added between *C* and *E* by any method, and draw a line *F G*, cutting off from the top of the card an equal area *A B G F*. A hyperbolic compression line *F H* drawn through *F* is the line desired.

Proof.—Draw two auxiliary hyperbolas, *c d* and *a e*, near the hyperbola *F H*, and consider the areas *K, G, E, L*, etc., in relation to the lines *E L*, etc. We shall then have $K\,G\,E\,L : F\,G\,E\,H : K\,F\,H\,L : e\,F\,H\,a : F\,f\,e\,H = E\,L : E\,H : H\,L : H\,a : e\,H$, and, if we suppose these areas and lines to be measured by suitable scales, the areas will represent quantities of work, and the lines the weight of steam performing that work. Also

$$\frac{F\,G\,E\,H}{E\,H} = \frac{A\,B\,C\,H\,F}{E\,H} = \frac{K\,G\,E\,L}{E\,L} = \frac{K\,F\,H\,L}{H\,L} = \frac{e\,F\,H\,a}{H\,a} = \frac{F\,f\,e\,H}{e\,H} = U$$

the work done per pound of steam for the card *A B C H F* or *F G E H*.

It remains now to show that the cards *A B C c d* and *A B c a b* are less economical, and this appears as follows:

Let $\frac{A\,B\,C\,c\,d}{E\,c} = r$ = work per pound of

the first card; we are to show that $v < U$. From the above equations we have,

$$\frac{A\,B\,C\,H\,F - F\,f\,e\,H}{E\,H - e\,H} = U, \text{ whereas,}$$

$$\frac{A\,B\,C\,H\,F - F\,f\,e\,H - F\,f\,d}{E\,H - C\,H} = v$$

therefore $v < U$.

Again, let $\frac{A\,B\,C\,a\,b}{E\,a} = u$; to show that $u < U$.

The equations give

$$\frac{A\,B\,C\,H\,F + e\,F\,H\,a}{E\,H + H\,a} = U, \text{ whereas}$$

$$\frac{A\,B\,C\,H\,F + E\,F\,H\,A - F\,e\,b}{E\,H + H\,a}, \text{ therefore } u < U.$$

Consequently the most economical compression line is *F H*.

When steam is expanded to back pressure as in the card *F G E H* the compression should just fill the clearance, and authors generally agree with this. In such a card, however, any greater compression, as along *e f* (giving the card *f G E e*) is equally economical though it reduces the capacity of the engine.

Cotterill's expression,

"Greatest work $= P_1\,V_1 \log_e R$,"

follows directly from the above, because the greatest work $= V = \frac{K\,G\,E\,L}{E\,L}$, thus,

$P_1\,V_1 = G\,g \times K\,G$ and $R = \frac{E\,L}{G\,K}$, consequently $K\,G\,E\,L = P_1\,V_1 \log_e R$, in

which, if we take V_1 as the volume of one pound of steam, $E\ L$ becomes unity, and the two expressions identical.

In this method of treating the question the corners of the card at A, B and D may be rounded, as in an actual card, without affecting the accuracy of the results, provided only that the points E, G and H are not interfered with, $G\ E$ being a hyperbola, and $H\ E$ a horizontal line. Between F and G (*via* A and B) and between G and H (*via* C) the card, then, can have any shape and we have only to make the actual card areas,

$$A\ B\ G\ F\ A = G\ E\ H\ C\ G.$$

By throttling the steam and increasing the stroke we may reduce the pressure and change the card $A\ B\ C\ H\ F$ into $F\ G\ E\ H$, with no theoretical loss of economy.

A MECHANICAL INDEX.

By C. WELLMAN PARKS, WASHINGTON, D. C.

Various methods of indexing were described, and the difficulties that have been found in the practical working of the same were discussed. The division of engineering literature under various heads was exhibited, and the Dewey Classification recommended. The proposed index would be printed weekly, and would be so arranged as to avoid the necessity of consulting more than two alphabetical lists to find any article that had been published during the year.

It was proposed to set the index entries in type on a machine similar to the linotype. The machine would differ in the respect that it would set bold face, italics, and roman, in the same line. Each line of type, being cast solid, can be handled as cards are handled in an ordinary card catalogue.

When an index for a week had been printed the type would be replaced on suitable galleys, and the new matter repaged and printed. The new issue of the index would make the issue of the previous week unnecessary for further use.

Professor Merriman stated that he had found a difficulty with the Dewey Classification, which was that very often books on nearly the same subjects would be placed on different shelves, notwithstanding the fact that those cataloguing the books were experts in this line of work. He considered the Dewey method, however, to be an excellent one. A general index in his opinion would be too cumbersome. He considered the catalogue issued by the Association of Engineering Societies to be all that is required.

AN ACCURATE METHOD OF MEASURING HEAVY LIQUID PRESSURES.

By D. S. JACOBUS, HOBOKEN, N. J.

This method was adopted, at the suggestion of Professor Webb, in measuring the pressure required to burst specimens of steel tubing. A modification of the most accurate method was employed in tests made at a later date. The pressures measured were as high as 25,000 pounds per square inch.

The most accurate method consists in employing a plunger of small diameter (about one-eighth of an inch) which is made to compress a spring by the action of the liquid pressure. An automatic diagram is taken, which shows the increase of volume of the tube as the pressure is increased and the corresponding pressures. This diagram resembles the curve of elongations corresponding to given loads obtained in tests of metal by tensile stress, and shows that the pressure increases at a nearly uniform rate for a given increase of volume until a point is reached corresponding to the elastic limit at which the law suddenly changes, and the increase of volume for a given increase of pressure becomes much greater.

The second method that has been successfully employed is to use a steel plunger of about three-quarters of an inch in diameter, both to produce and measure the pressure. The plunger is made to fit accurately into a heavy cast-iron piece so as to be just loose enough to sink into the hole by its own weight. The apparatus is filled with water, or oil, to within about two inches of the top of the hole, and the upper part of the hole is then filled with melted paraffine. After the paraffine cools the steel plunger is inserted. The paraffine prevents leakage, which would be excessive at pressures of over 15,000 pounds per square inch if the plunger acted directly against the oil or water, and special experiments have shown that the presence of the paraffine does not produce undue friction.

Engineering Association of the South.

By HUNTER MCDONALD.

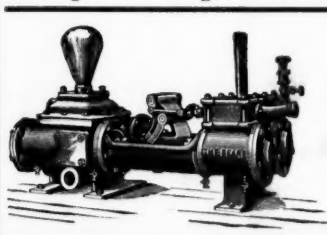
At the December meeting of this association Mr. G. D. Hicks, division superintendent, Nashville, Chattanooga & St. Louis Railway, presented a paper on the Hobbs Island Transfer, from which the following is condensed: Hobbs Island and Guntersville, Ala., are 20 miles apart, on opposite banks of the Tennessee River, and on one of the lines of the Nashville, Chattanooga & St. Louis Railway. This gap is closed by the Hobbs Island Transfer. The transfer plant consists of two stern-wheel steamboats, of 40 and 90 tons burthen, and two double track barges, one for four and the other for six cars; the lighter boat conveys the passengers, and the other, with the barges, the freight. Time between Hobbs Island and Guntersville, two hours for the passenger boat, and two hours and a half for the freight.

At each of the termini is an incline at the foot of which is a cradle, movable along the incline, so that the cars can be run upon the barges at all stages of the water. The river has a rise and fall of 40 feet at Hobbs Island, and 47 feet at Guntersville. The inclines are on a 3½ per cent. grade, along an earth fill, a pile trestle, a rip-rap bank, and at the bottom a crib where the nature of the river bed prevented driving piles.

The incline at Guntersville is, in part, on a 10 degree curve. The cribs are built of 12″x12″ timbers, layers of 12-foot lengths (8-foot centers) crossing layers of 25 foot lengths (3-foot centers), all drift bolted. These cribs were loaded with stone, then capped by 12″x12″ stringers, laid to grade, and bearing the 8″x9″ 10-foot ties, and on them the rails and 5″x9″ guard rails.

The cradle at Guntersville is novel, in that it is constructed to move on a 10-degree curve, as well as on a tangent. It consists of eight sections on wheels, and two sections on slides, each about 16 feet long; the first section carrying a 20-foot apron, and the last a feather rail. The sections are not rigidly connected, but by a bolt allowing about 5 inches play. The rails are laid with opposite joints, spiked only at the joints, and held together by tie bars. The rails outside on the curve are 1¼ inches longer than those on the inside; on tangent the openings thus formed are each filled by a short section of rail inserted and held by a split key passing through its web and the splice plates. The bolt holes in the rails are slotted. The cradle at Hobbs Island is on a tangent. The cradles are moved along the incline by a locomotive or by a steamboat.

The connection between the apron and the barge is unusual. The ends of the rails on the apron are turned outward at about thirty degrees at the junction, while the rails on the barge are beveled at their ends at the same angle. The latter rails are held together by five tie rods, the one nearest the



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Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
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Lexington, Mass.,
and 125 South 11th St.,
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SEBASTIAN LATHE CO.
117 & 119 Culvert St., Cincinnati, Ohio,
Manufacture ENGINE and SPEED Lathes, which are specially adapted and recommended for general Machine and Jobbing Shop, Electrical and Experimental Work.
High Grade Tools at Low Prices: Planers, Shapers, Drills, Emery Grinders, Grindstone Frames, Shop Outfits in Tools and Supplies.
Write for CATALOGUE and PRICES.

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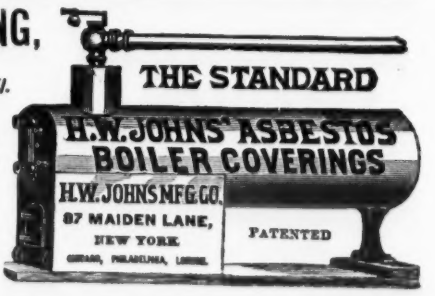
37, 51 and 62 Inch Swing, with Two Regular Heads.
42 INCH SWING, WITH TURRET HEAD, AND SCREW CUTTING ATTACHMENT.
All gears accurately cut. All feeds positive.
Machines are self-contained and therefore do not require an expensive foundation.
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, Prop. BRIDGEPORT, CONN.
New York Office, 39 CORTLANDT STREET, ROOM 86.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Malden Lane, NEW YORK.



beveled ends having a turnbuckle. Just back of this rod, a lever is arranged to lift the beveled rails clear of the apron, till the windlass has drawn the nose on the barge into the V on the apron, the gauge having been lessened by the turnbuckle. Then the beveled rails are lowered into place, and the gauge restored by the turn buckle, making the rails continuous from the barge to the cradle.

The cost of the steamboats and barges was $30,368; cost of the crib and cradle at Hobbs Island $4,043 and $837, respectively; and at Guntersville $3,045 and $961, respectively.

Railway making is beset with unforeseen obstacles in China. A line is being made from the interior of Manchooria to the coast, and it was lately proposed to make a junction with Moukden, the chief town. The engineers consulted the Tartar General, and the General, before giving his sanction, consulted the geomancers, who declared that if the line were laid along the proposed track, the vertebræ of the dragon that encircles the city would be broken by the nails of the sleepers. Such a contingency was too awful to contemplate, and the General promptly informed the engineers that the thing was impossible. The latter, in despair, lodged a protest with Li Hung Chang, who, whilst commending the caution of his subordinates, expressed it as his opinion that the hidden dragon would suffer no harm, rather otherwise, by the innovation. However, he would refer the matter to the Emperor. This struck terror into the heart of the General, and he again consulted the geomancers. Eventually a line was traced some hundreds of yards away from the site at first proposed.—*Indian Engineering.*

MANUFACTURES

We are informed by the Connersville Blower Co., Connersville, Ind., that they are compelled to run overtime to fill orders and forced to make an addition to their plant.

The Buffalo Steam Pump Co., North Tonawanda, N. Y., has issued an 1894 catalogue of steam pumping machinery. A variety of pumps for different purposes are illustrated and described.

The Bessemer plant of the Maryland Steel Co., at Sparrow's Point, Md., lately resumed operations on an order for the Pennsylvania Railroad Co., and is now rolling for the New York, New Haven & Hartford Railroad.

L. S. Starrett, Athol, Mass., has issued a very comprehensive catalogue and price list of small tools for machinists, patternmakers, engineers and mechanics generally. It is completely illustrated and will be sent free on application.

Markt & Co., Limited, 87-95 North Moore street, New York, agents for Eicken & Co. Steel Works, of Hagen, Westphalia, issue a folder relating to crucible cast-steel for tools and a variety of purposes; also forgings, etc., of steel, solid wrought anvils and other products.

The Marinette & Menominee Paper Co., of Marinette, Wis., are erecting an additional building to their already extensive plant, to be utilized as a general machine shop. They have contracted with the Lodge & Davis Machine Tool Co., of Cincinnati, O., for one of their large planers, several of their lathes, drill presses, bolt cutters, etc.

A note from Mossberg Mfg. Co., who make special machinery and jewelers' tools at Attleboro, Mass., says: "We are pleased to say that since going into our new factory in September our business has grown to such an extent that in order to keep up with our orders we shall be obliged to make several additions to our plant in the line of 14" to 18" engine lathes, milling machines, shapers, upright drills and screw machines."

While it is not decided upon and no definite arrangements have been made, the Tonkin Boiler and Engine Co., of Oswego, N. Y., a new concern now building boilers only, we are informed, talk of beginning the erection, in the spring, of machine shops, 65x300 feet, adjoining their present boiler shop. The company owns twenty acres of land on the lake front. Mr. Tonkin, of this company, is also president of the Oswego Tool Co., of the same city, who manufacture a variety of boiler makers' and pipe tools.

The *Pittsburg Gazette* says: The employes in the puddling department of the Hubbard Iron Company's Works, Youngstown, are making arrangements to organize a co-operative company and run the rolling-mill at Hubbard under the management of William F. Bonnell. A meeting of the puddlers was held to day and it was decided to secure a lease, purchase the necessary stock and light the fires, if possible the coming week. The employes will leave part of their wages as capital to carry it on. The merchants of Hubbard will assist the men by giving credit, and the indications are that it will prove successful.

The city of Boston has followed New York in recently awarding to the George F. Blake Mfg. Co contract for one of their high duty pumping engines. Like the pumping engines for the new aqueduct, New York City, this pumping engine will be of the vertical triple-expansion rotative type and provided with an automatic Corliss valve gear, capacity being ten million gallons per 24 hours, working with a steam pressure of 160 pounds per square inch. This is the fifth pumping engine of this type that the George F. Blake Mfg. Co. have secured contracts for within the last month.

The Oswego Tool Company, Oswego, N. Y., issue a circular of tube expanders, hand punches for boiler makers, stay-bolt taps, pipe vises and wrenches, etc. They say of tube expanders: "We have had a great many complaints that the bodies, guards, and collars of the ordinary type of Dudgeon roller tube expanders are too soft and do not wear as they ought. As you are doubtless aware, the duty an expander is called upon to perform is most arduous and trying, and in order to produce a durable expander it must be built throughout of the very best materials, and all bearings and parts where there is any wear must be hardened. We have given a great deal of time and thought as to the best method of increasing the life and durability of the roller expander, and have produced our "World's Champion" Dudgeon expander as a result of our experiments, extending over a period of fifteen years. The body, guard, and collar of this expander are made from a special metal and hardened by a process known only to ourselves. As a result, these parts will outwear the same parts of six expanders of the ordinary type."

The Ames Iron Works, Oswego, N. Y., have nearly completed and have begun to equip with tools and occupy their new machine shops, in size 100x400 feet, which are to be devoted, in connection with their existing plant, to the systematic manufacture of the Armstrong automatic steam engines as previously illustrated in our pages. The erecting shop has the height of two floors, while the main building is three stories, except at the front end where the drawing-rooms and the office of the superintendent, Mr. E. J. Armstrong, add a fourth story to the building. The style of construction is of the New England mill type and very substantial, the beams, posts and girders being built up from heavy planks. The building has an outer covering of brick four inches thick, which is quite independent of the main structure. A striking feature of the building is the plentiful window space, making it very light, the windows being of ribbed glass, admitting light without glare, while preventing outsiders from peering in. An electric crane will be provided for the erecting shop. The building is well equipped with elevators, and the machine shops, when fully equipped with tools, will be well adapted for the purpose intended. At present 12 sizes of automatic engines are being manufactured, ranging up to 225 horsepower, and larger sizes will soon be ready for the market. The establishment also builds boilers, 1,100 having been turned out in 1892, the present year's production being, of course, less, owing to the depressed condition of general business throughout the country.

Machinists' Supplies and Iron.

NEW YORK, January 6, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.00 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $12.00 to $13.00 for No. 2, and $11.25 to $12.00 for Gray Forge.

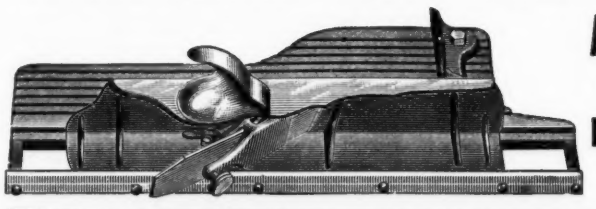
Antimony—The market is quiet and steady. We quote L. X., 9½c. to 9.75c.; Cookson's, 9.95c. to 10c.; Hallett's, 9c. to 9.05c., and U. S. French Star, 10c.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.

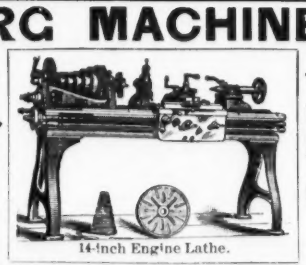
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



A. J. WILKINSON & CO.
180 to 188 WASHINGTON ST.,
BOSTON, MASS.
SEND FOR CIRCULAR.

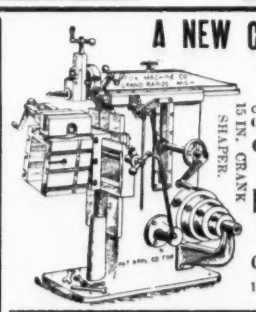
FITCHBURG MACHINE WORKS,
MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
SEND FOR CATALOGUE E.


14-inch Engine Lathe.

THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
FITCHBURG, MASS.

LATHES,
PLANERS,
DRILLS,
AND OTHER
IRON WORKING TOOLS.
Before ordering send us a memorandum of your requirements.
COOKE & CO.,
163 & 165 Washington St., NEW YORK.

A NEW CRANK SHAPER.



NOVEL, YET SIMPLE.
Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
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325 Nor. Front St.,
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JUST READY.
A Catalogue of Books and Pamphlets on Social Sciences, Political Economy, the Tariff, the Currency, the Finances, Population, Pauperism, Charity, the Land Question, etc. 32 pages, 8vo, sent free to any one in any part of the world who will furnish his address,
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Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
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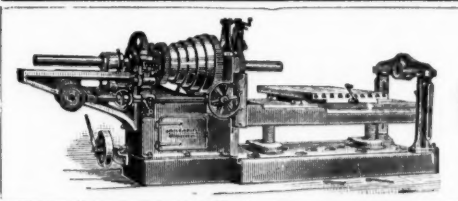
No.			Price.
1	⅛ to 1	in.	$10
2	1	" 1½ "	14
3	1½	" 2 "	18
4 (with screws)	2	" 3 "	32
5 " "	3	" 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.



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WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!
Chicago Office: 14 South Canal St.

BUILDERS IRON FOUNDRY,
PROVIDENCE, R. I.
Gun-Iron Air Furnace Castings, Engine and Machinery Castings, Loam and Dry-sand Castings, Pneumatic Tubes and Caissons for Bridge-Piers, Globe Special Castings for Water Works, The Venturi Meter, Special Machinery, Accurate and Heavy Machine Work.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

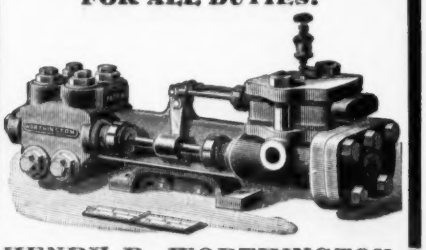
Burnham's Sensitive Drill.

SEND FOR CIRCULAR.
THE GEO. BURNHAM CO., Worcester, Mass.

EICKEN TOOL STEEL,
Works at
HAGEN, WESTPHALIA, GERMANY.
ADAPTED TOOL STEEL FOR SPECIAL USES.
SPECIAL No. 3 has no equal for use on very HARD MATERIALS.
MARKT & CO., AGENTS, 78 & 80 N. Moore St., NEW YORK.

"Star" Foot Lathe Swings 9x25 in.
LA LATHE HE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes, Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.



HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

Lard Oil—Prime City is quoted at 70c. to 71c.

Copper—The market is weak. Lake Copper is quoted at 10.20c. to 10.25c. Demand is very light. Casting Copper is held at 9.50c. to 9¾c.

Lead—The market is dull; there are sellers at 3.20c. to 3.25c. Demand is light.

Spelter—The market is weak; some brands are offered at 3.50c. to 3.60c. for New York delivery, but this does not attract buyers.

Tin—The market is weak. Jobbing quantities are obtainable at 20.50 to 20.60c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Draftsman and vise hand wishes pos., has exp. in designing haulage mach'y. H. X., AM. MACH.

Wanted—Pos. by draftsman and mach., 10 yrs. exp., gen. mach'y; good refs. Camera, AM. MACH.

Draftsman, Swedish grad., 6 years exp., wants position. H. M., AMERICAN MACHINIST.

Position Wanted—By young man 27; mech. eng. and draftsman. Refs. A1. R. A., AM. MACH.

Engineer wants pos. as first ass't in some electric light or power station. Engineer, AM. MACH.

Draftsman and machinist wants situation on small machinery; experimental knitting or sewing machines preferred. "Jig," AMERICAN MACHINIST.

Sit wanted as foreman or ass't foreman, layer out or dftsman in boiler shop; thor. exp. X., AM. MACH.

Designer and draftsman with shop experience; first class man, wants position. W. S., AM. MACH.

Wanted—Foremanship by one of exp; engines, pumps, or gen. repairing. Indicator, AM. MACH.

Wanted—Situation in charge of designing & mfg. steam, hydraulic or mining mach'y. M. E., AM. MACH.

Wanted—Pos. as foreman. Have handled 100 men. Exp., principally in mach. tool building. Educated. Thoroughly prac. Age, 31. Pusher, AM. MACH.

Wanted—Position in charge of sales of machinery or tools, N. Y. or Chicago preferred. Address Experience, AMERICAN MACHINIST.

Situation wanted by first-class machinist; had experience in die and tool making. Address F. C. Politz, Falls Village, Conn.

Chemist—A young man thoroughly familiar with the chemistry and analysis of iron, steel, etc., desires position. Chemist, AM. MACH.

Experienced traveling salesman wants position; well acquainted with trade and mfrs. and can sell goods; A1 refs. Address Box 146, AM. MACHINIST.

Situation wanted by A1 tool maker and machinist; 12 years' experience; age, 31; good references; 2 years' experience as foreman. Box 144, AM. MACH.

Wanted—Position by A1 man as superintendent of boiler works or layer out; good references. Address Box 148, AMERICAN MACHINIST.

Young Norwegian, age, 22, tech. school graduate, with mach. shop exp., wants position as draftsman; salary moderate. Box 147, AM. MACHINIST.

Wanted—A manager or supt. for an old and well-equipped mach. shop and foundry. To the right party a half interest will be sold very low. Address Box 143, AMERICAN MACHINIST.

Wanted—Situation by draftsman and shop supt. (Am.) 35 years old; exp'd in power transmissions & gen. mill furnishing; competent to plan & estimate on erection, etc.; good refs. J. P., AM. MACHINIST.

Supt. wanted for a general machine works and foundry (about 100 men), must be well up in all modern machinery and methods, and particularly posted on boilers, engines and mill machinery; competent to make complete estimates and drawings; sobriety and temperance an absolute requirement; state nationality, age, salary required, & give refs.: location, N. J. Trenton, Box 145, AM. MACH.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Hand pipe threader 4", $67; monitor lathe, $95; screw-cutting lathes, all sizes, cheap. 229, AM. MACH.

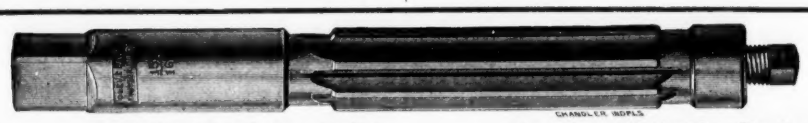
Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

Agents—$5 Speed Gage, new, valuable, sells; shows constantly speed and slightest variations; Geo. T. McLauthlin & Co., 120 Fulton St., Boston.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

For Rent—Machine shop favorably located in Norfolk, Va., containing following tools: 1 36"x40'x15 foot planer, 1 48"x14' 6" lathe, 1 26'x25' lathe, 1 30"x15' lathe, 1 17"x6' lathe, 1 4½-foot radial drill, 1 20" drill, 1 25" stroke shaper, 1 bolt and pipe cutter, 1 key-seater; a very favorable lease will be made to good party. Address L., care of AMERICAN MACHINIST.



Established in 1874.
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Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
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MACHINE TOOLS OF MODERN STYLE
in FIRST-CLASS ORDER will be SOLD LOW BEFORE REMOVAL out of a SHOP JUST BOUGHT OUT.

Gould & Eberhardt 25 in. Upright Drill, with Back Gear and Automatic Feed.
Blaisdell, 40 in., Upright Drill, extra heavy, with Back Gears and Automatic Feed.
Blaisdell Engine Lathe, 13 in. x 6 ft.
Fitchburg " " 14 " 8 "
Perkins " " 15 " 6 "
Ames " " 16 " 8 "
Hendey " " 18 " 10 "
Putnam " " 20 " 8 "
Fitchburg " " 24 " 12 "
Lodge-Davis-Fox Monitor, 15 in. x 6 ft.
Bogert Hand Lathe, 14 in. x 6 ft.
Gould 8 in. Stroke Crank Motion Shaper.
Improved 15 in. " " " "
Improved 36 in. Gear Cutter—cuts Spur Bevel—Spiral and Worm Gears, extra heavy.
Cincinnati Standard Size Milling Machine.
Lincoln Milling Machine.
Upright Boring and Turning Mill, 38 in. swing with Two Heads.
Brown & Sharpe Vertical Turret Machine, 36 in.
Whitcomb Planer, 20 in. x 4 ft.
Hewes & Phillips Planer, 35 in. x 7 ft.
Ferracute Inclined Frame Punch Press.
Stiles Pattern No. 2 Punch Press.
Bement Steam Hammer, 300 lbs.

LARGE STOCK, NEW IMPROVED TOOLS OF THE BEST STANDARD MAKES.

Boiler Bending Rolls, Improved Style, 6, 8 and 10 ft., with Hinged Housings.

J. J. McCABE,
SUCCESSOR TO E. P. BULLARD'S
N. Y. Mach'y Warerooms.
14 Dey St., NEW YORK.

SECOND-HAND MACHINE TOOLS.

ENGINE LATHES.
1 15 in. x 5 ft. Flather.
1 15 " 6 " Jones & Lamson.
2 15 " 7 " S. C. Wright.
1 15 " 8 " Fitchburg.
1 16 " 7 " Bement.
1 16 " 6 " New Haven.
7 16 " 6 " F. E. Reed.
2 16 " 8 " F. E. Reed.
2 16 " 6 " Prentice Bros.
1 16 " 6 " Perkins.
2 18 " 8 " Wm. Munzer.
1 20 " 6 " E. P. Bullard.
20 in. x 10 ft. Putnam.
1 26 in. x 10 ft. New Haven.

PLANERS.
1 15 in. Lathe and Morse Crank.
1 20 in. x 20 in. x 6 ft. Pratt & Whitney.
1 22 in. x 22 in. x 4 ft. Pond.
1 24 in. x 24 in. x 5 ft. New Haven.
1 28 in. x 28 in. x 7 " " "
40 in. x 40 in. x 9 ft. Pond Mach. T. Co.

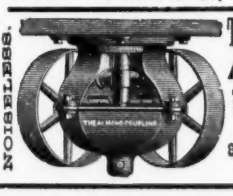
SHAPERS.
1 6 in. Boynton & Plummer,
1 10 " " "
2 15 " Juengst, Friction.
1 24 " Hendey, Friction.
2 15 " Wood, Light & Co.
1 18 " Putnam, Traverse Head.

DRILL PRESSES.
2 10 in. 3-Spindle Slate.
2 Garvin, Bench.
2 Garvin, No. 2, 4-Spindle.
1 Pratt & Whitney, 3-Spindle.
2 Pratt & Whitney, 4-Spindle.
1 Garvin, No. 4, 6-Spindle.
1 20 in. Blaisdel, Sliding Head.
1 22 " Prentice, B. G., P. F.
1 24 " Cincinnati, Sliding Head.
1 25 " Blaisdel, B. G., P. F.
1 24 " Prentice, B. G., P. F.
34 in. Putnam, B. G. and S. H.
5 ft. Niles Universal Radial.

MISCELLANEOUS.
2 14 in. x 5 ft. Fox Lathes, Square Arbor.
1 Whiton 2-Spindle Centering Machine.
1 No. 1 Brown & S. Surface Grinder.
1 No. 2 Brown & S. Surface Grinder.
2 36 in. G. & E. Auto. Gear Cutters.
2 Garvin Auto. Gear Cutters.
1 6 in. Bement Slotter.
1 10 in. Newton Slotter.
1 No. 2 Nat. Single Bolt Cutter.
1 " " " Double " "

Also, large variety of other machines. Write for complete list and detail description.

THE GARVIN MACHINE CO.,
LAIGHT & CANAL STS., NEW YORK.



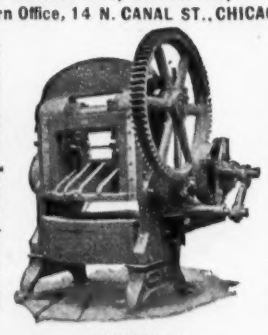
The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

AMERICAN WATCH TOOL CO.
Waltham, Mass.

LATEST IMPROVEMENTS.
NEW STYLE.
NEW PRICES.
GROWING RAPIDLY in FAVOR

BLAKE & JOHNSON,
WATERBURY, CONN.
Builders of WIRE FORMING MACHINES
With F. B. Manville's Patent Sliding Former,
For making articles from the coil, of either round, half-round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.
☞ Bicycle and Labor Saving Machinery a Specialty.

E. W. BLISS CO.,
1 ADAMS ST., BROOKLYN, N. Y.
Western Office, 14 N. CANAL ST., CHICAGO, ILL.



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Dies, Shears and Special Machinery.
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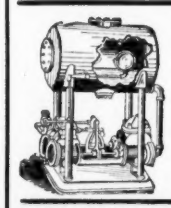

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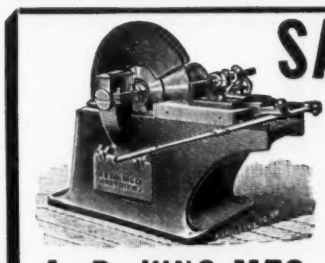

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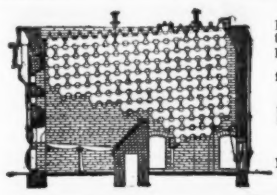

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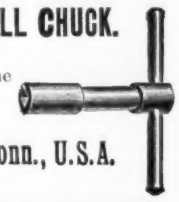

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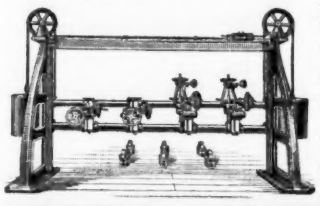

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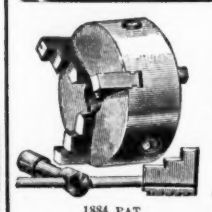

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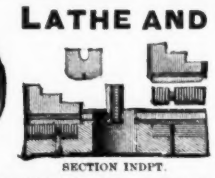

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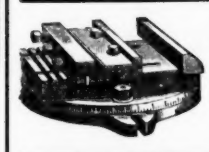

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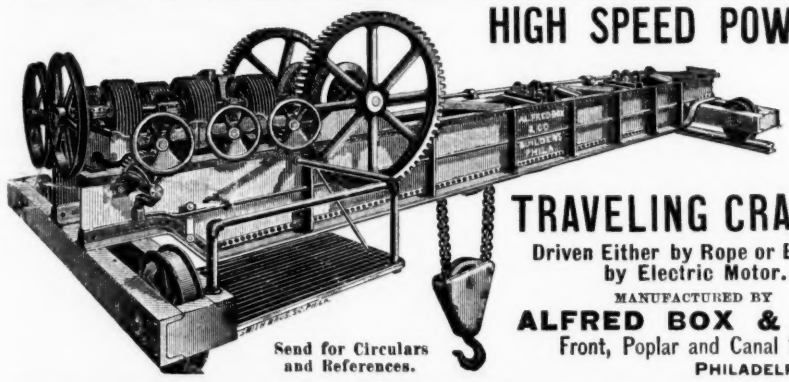

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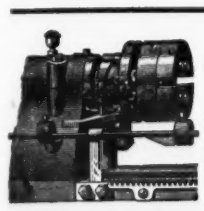

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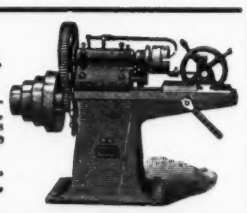

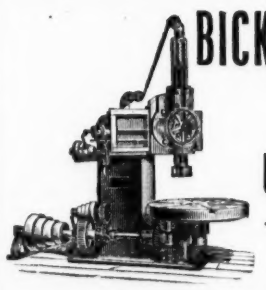

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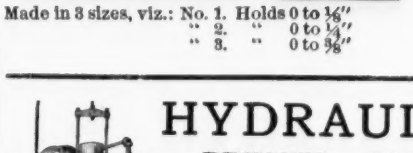

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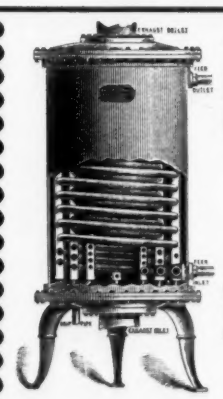

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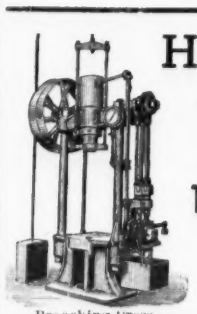

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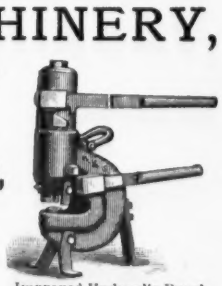

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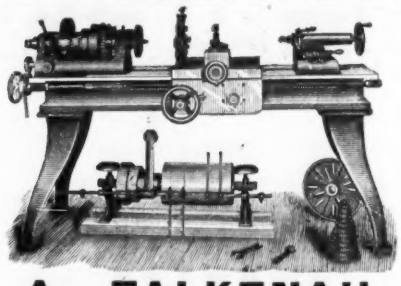

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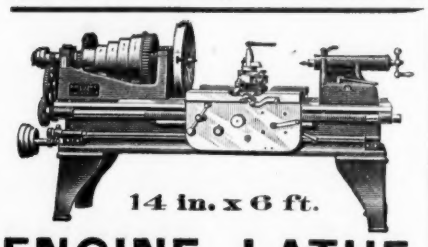

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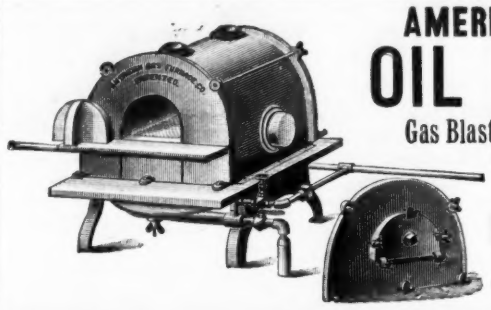

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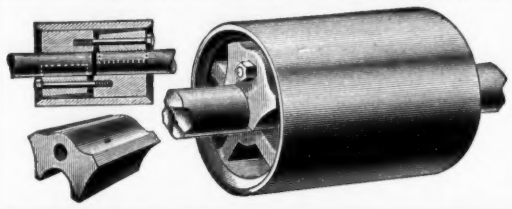

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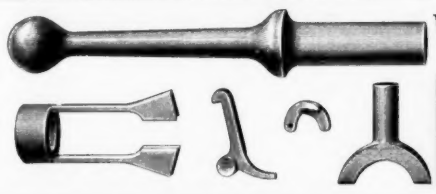

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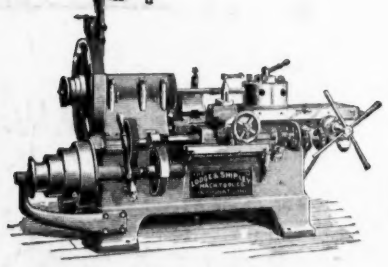

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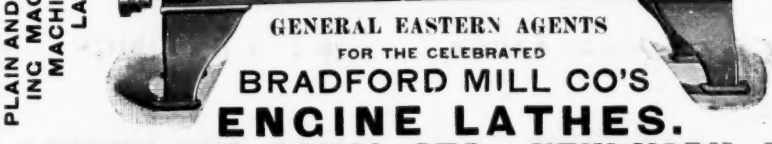

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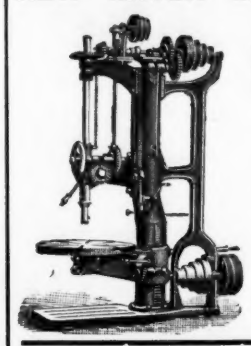

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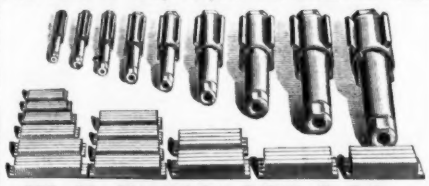

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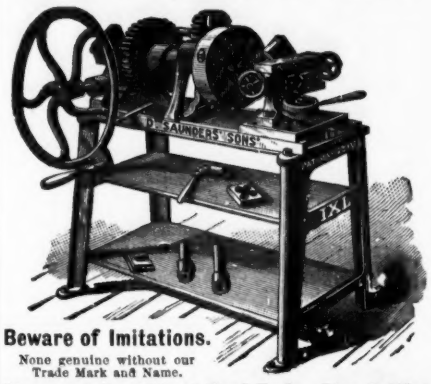

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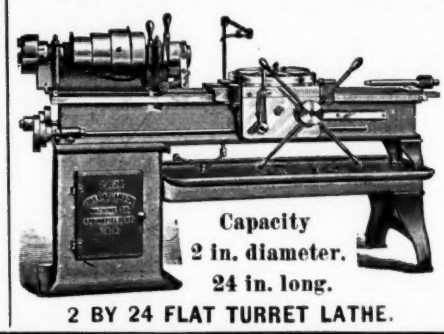

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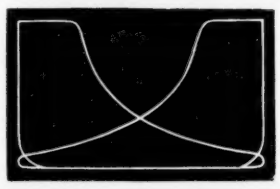

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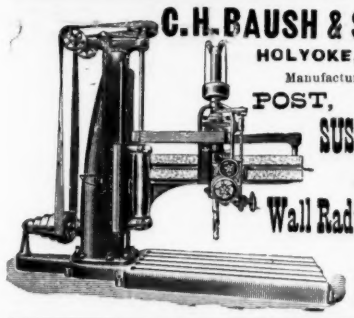

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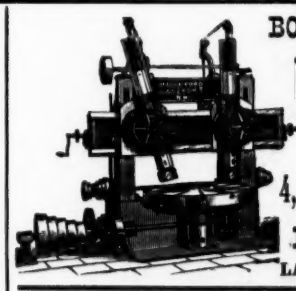

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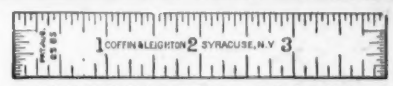

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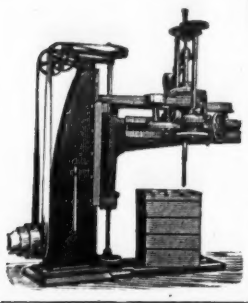

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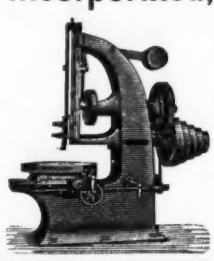

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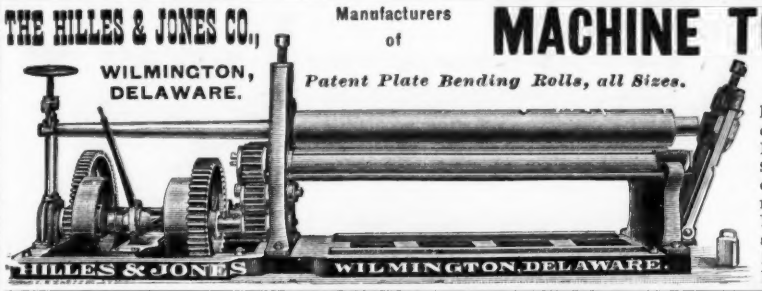

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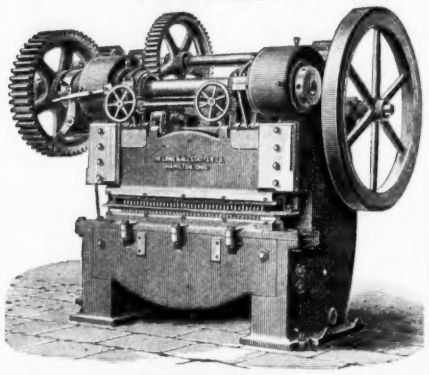

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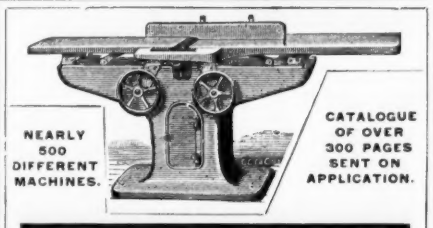

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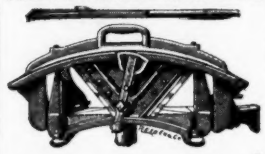

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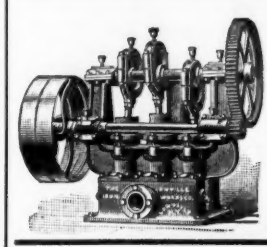

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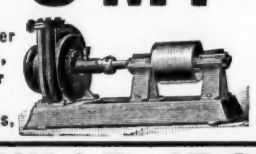

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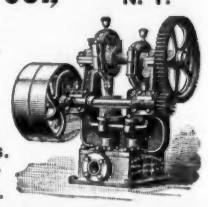

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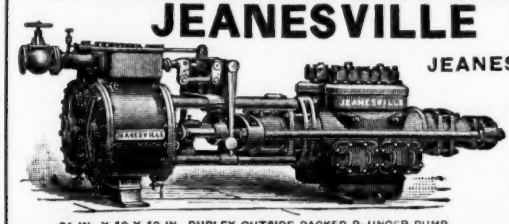

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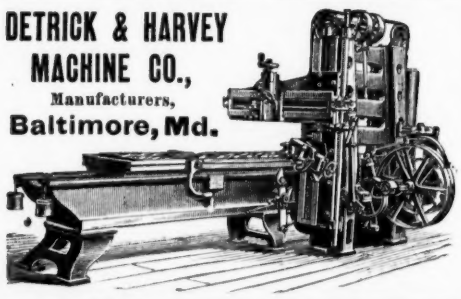

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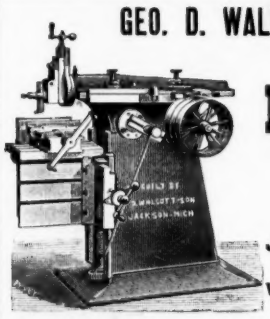

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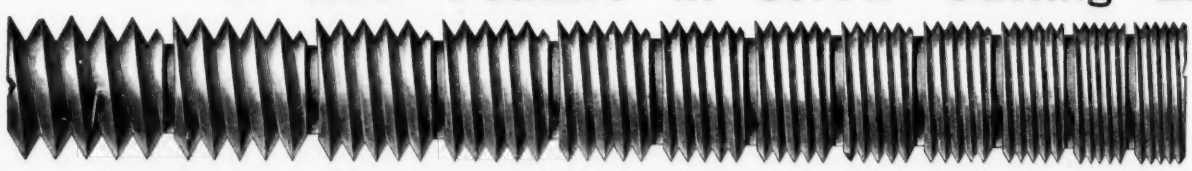

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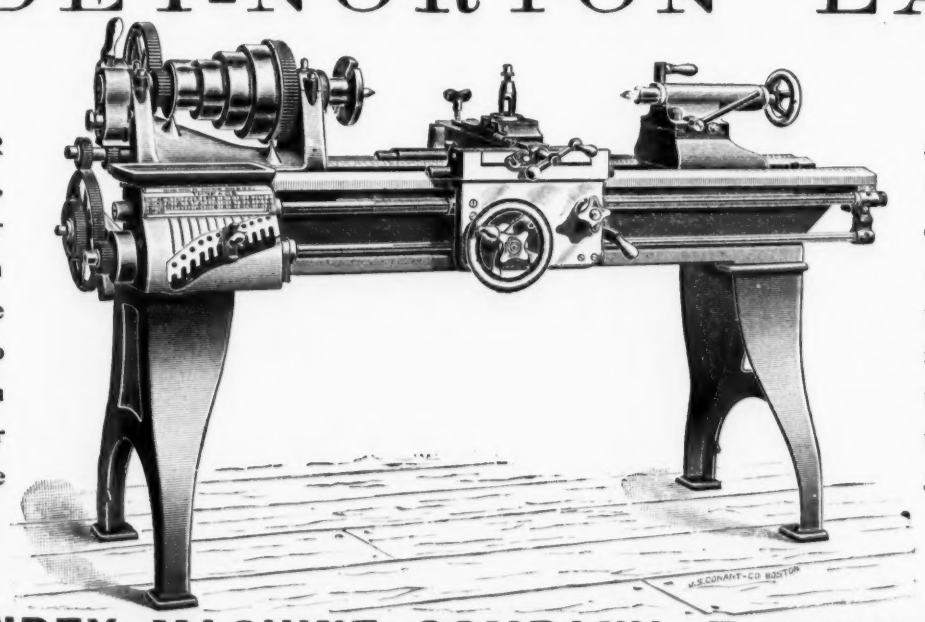

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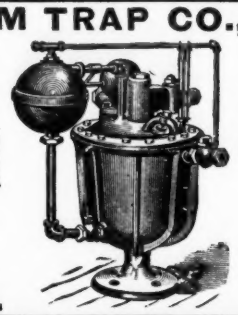

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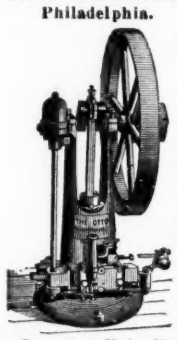

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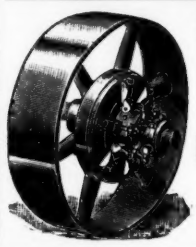

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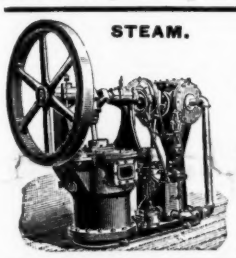

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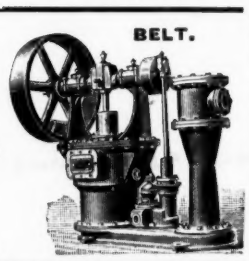

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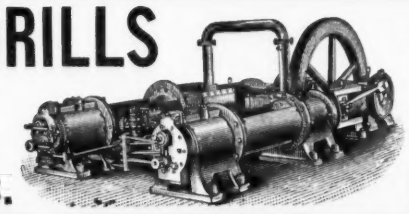

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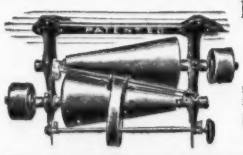

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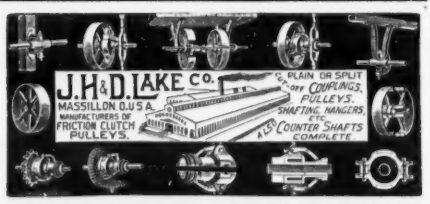

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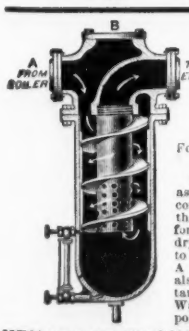

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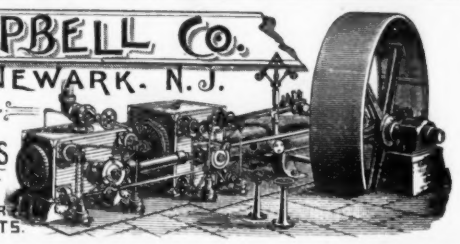

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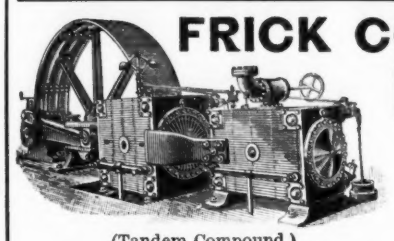

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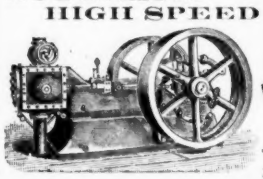

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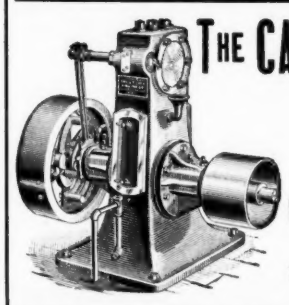

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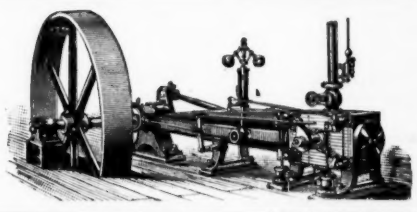

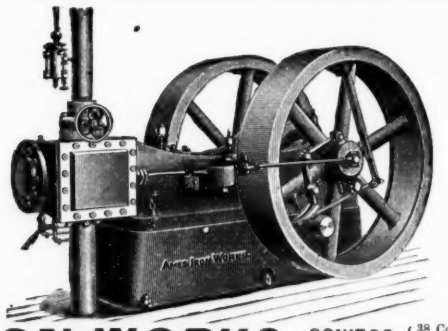

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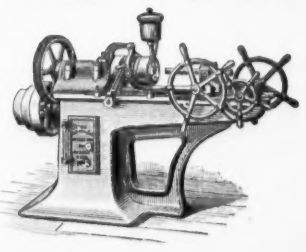

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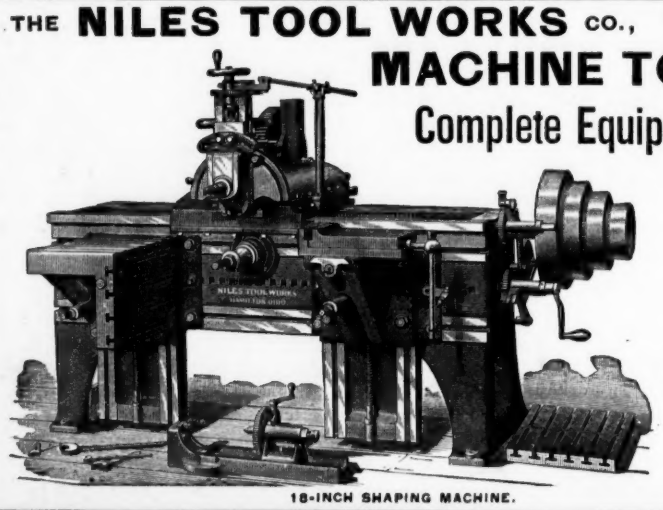

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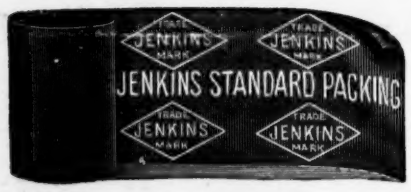

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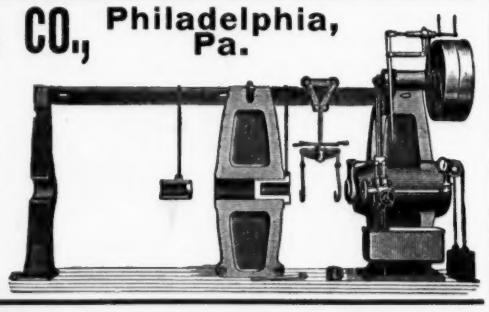

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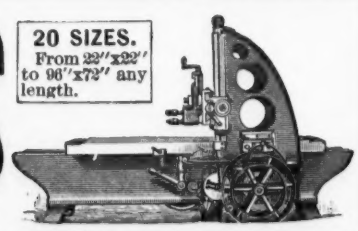

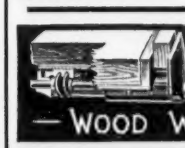

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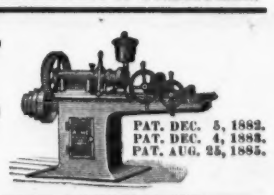

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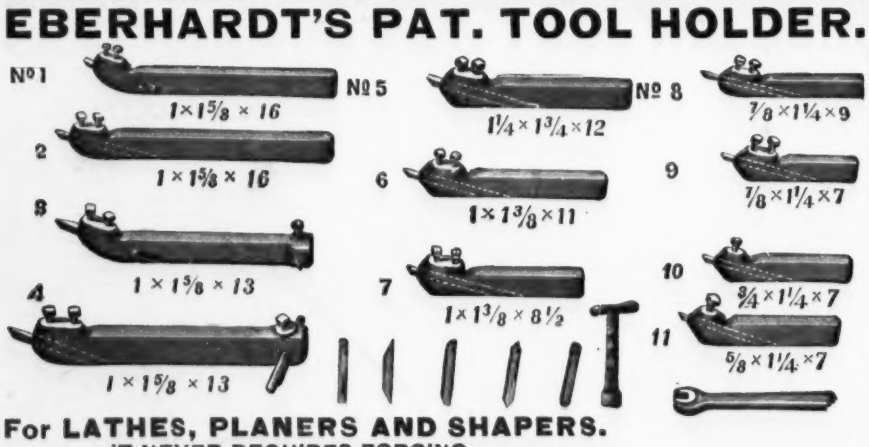

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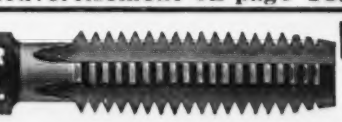

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